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NONCYANIDE STRIPPER PLACEMENT PROGRAM

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The objective was to evaluate commercially available noncyanide metal strippers for replacement of cyanide metal strippers used by the Air Force. Laboratory tests were conducted on coupons made from materials commonly subjected to cyanide stripping solutions. These included samples of plate metals, basis metals, and masking materials. The stripping rates for plate metals, effects on the surface of basis metals, and solvation properties of masking materials were determined in solutions of noncyanide strippers obtained from commercial sources. In addition, the solutions were tested for biodegradability under conditions similar to those in the Air Force Industrial Wastewater Treatment Plants (IWTPs). The information obtained from these tests indicates that several noncyanide strippers will be technically acceptable as replacements for cyanide formulations currently used by the Air Force.

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EXECUTIVE SUMMARY

The noncyanide replacement program requires three phases to evaluate currently used stripping technologies and new alternative stripping technologies, and develop and implement new technologies. Phase I, reported herein, consists of two primary tasks: (a) gathering and categorizing available information concerning cyanide and noncyanide processes, and electroplating, stripping, and cleaning solutions, and (b) conducting laboratory studies using commercial noncyanide strippers and coupons representative of plate and basis metals used at Kelly AFB.

Phase II will also have two parts. Field Test Verification studies will be conducted at Kelly AFB to test the most promising new technologies on aircraft parts under conditions nearly identical to those being used in the electroplating shop. A concurrent investigation will study the mechanisms of surface coating stripping by cyanide and noncyanide strippers. This will include an investigation targeted for developing and testing noncyanide silver strippers and an economical process for recovering the silver stripped in the noncyanide process.

In Phase III, those technologies found acceptable as alternatives to cyanide processes will be implemented in the Kelly AFB electroplating shop. Additional noncyanide formulations and processes will be developed and tested for applications where acceptable technologies were not commercially available or successfully demonstrated.

This report presents the foundation for the work performed in Phase I of the Noncyanide Replacement Program, the experimental procedures used in the work, the experimental data obtained from the laboratory studies, the results and conclusions summarized for the work performed, and recommendations for work to be performed in Phase II.

Twenty three commercial noncyanide strippers were tested for stripping performance on 10 plate metals and 3 masking materials, and for detrimental corrosion effects on 12 basis metals. Three generic strippers were also tested on the same materials to obtain baseline information on strippers

used at the Air Logistics Command centers (ALCs). Many of the strippers examined to date perform as indicated by the manufacturer. In some cases, basis metal corrosion was occasionally encountered or acceptable stripping rates were not observed for the plate metals. All of the strippers, except those containing sulfuric acid, were compatible with the three masking materials.

Biodegradability data were generated on all the components of the commercial products. Those strippers that performed acceptably in stripping tests are either biodegradable or have low initial COD values at dilutions expected in the ALC IWTPs, and are thus acceptable. To properly assess the waste disposal problems the nonbiodegradable strippers need to be processed through a complete waste treatment system.

The screening tests indicated acceptable performance characteristics, within the limits of laboratory evaluation, for eight noncyanide strippers. These offer high potential for eventual incorporation into ALC process lines. Before recommending products for technology transfer and initiation of new processes, further tests need to be performed on a larger scale where closer monitoring and control can be maintained.

PREFACE

This report was prepared by Idaho National Engineering Laboratory, EG&G Idaho, Inc., P.O. Box 1625 Idaho Falls, Idaho 83415 under Contract Number DE-AC07-76ID01570 for the Air Force Engineering and Services Center (AFESC), Tyndall Air Force Base, Florida 32403-6001. Mr Charles J. Carpenter was the Government technical program manager. This report summarizes work accomplished between 1 October 1987 and 30 September 1988.

This report has been reviewed by the Public Affairs Office and is releasable to the National Technical Information Service (NTIS). At NTIS it will be available to the general public, including foreign nations.

This technical publication has been reviewed and is approved for publication.

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SECTION I
INTRODUCTION

A. OBJECTIVE

The purpose of this program is to develop and implement the technology required to eliminate the cyanide wastes presently produced in the cyanide stripping processes used at Kelly AFB. The work was conducted to evaluate commercially available noncyanide strippers with potential application in the Kelly AFB electroplating shop. Three performance criteria were evaluated: (1) stripping performance, (2) operating conditions, and (3) biodegradability. These performance characteristics were determined experimentally under conditions acceptable at Kelly AFB. Acceptable performance in these three areas provides the technical foundation to warrant further studies before implementing these new technologies. The overall objective for Phase I was to evaluate these new formulations and processes on a laboratory scale as a preliminary screening to select technically acceptable processes for scaled-up tests with aircraft parts.

B. BACKGROUND

Electroplating shops use and generate large volumes of aqueous solutions containing cyanide. These cyanide solutions are used as cleaners, smut removers, metal and other coating strippers, and in electroplating baths. The capacity of the cleaning, smut-removing, and metal- and coat-stripping solutions is exhausted with use and must be frequently changed and/or disposed. The spent solutions, typically high in cyanide and metal concentrations, require special treatment and disposal procedures. Also, large volumes of dilute solutions are generated during rinsing. Most of the metals may be recovered or precipitated from these solutions with standard technologies such as ion exchange recirculation or sodium sulfide/ferrous sulfate precipitation, respectively (Reference 1). Metals complexed to cyanide, however, are not easily removed from solution because of the strong complexing nature of the cyanide ligand. The two major problems with

cyanide solutions are then related to worker safety and waste disposal. If suitable noncyanide formulations can be substituted for the cyanide stripping solutions in electroplating shops, both problems can be greatly diminished.

Electropl-.ing facilities ranging from operations of three to four baths to those covering over 40,000 square feet of floor space are operated by the United States Air Force (Reference 2). The operations support local maintenance and major engine and airframe overhaul. In these operations, large amounts of cyanide are used in solutions to strip plate metals and surface coatings from aircraft parts, to clean materials before electroplating, and in electroplating solutions. Other tanks are contaminated with cyanide by drag-in during the rinsing process. The spent solutions containing cyanide are considered hazardous wastes, and are a significant portion of the total electroplating waste generated at the Air Logistic Command (ALC) centers (Reference 3).

In the past, strippers were selected upon consideration of their performance directly related to the stripping process:

- o Effectiveness of the process
- o Time required to remove the coating
- o Cost of the operation
- o Reliability of the process.

Although these criteria are important, they are no longer the only considerations in the choice of strippers. The list has been expanded to include:

- o Method of waste treatment
- o Health hazards to personnel
- o Product safety
- o Materials recovery
- o Energy conservation
- o Public opinion.

Some of the last six criteria have, in fact, been given higher priority in selecting a stripper than the first four. This is in response to stringent waste disposal laws recently enacted or forecast for enactment, and due to passage of the Occupational Safety Hazards Act (OSHA).

Cyanide strippers have been used commercially to strip a large variety of plate metals and other surface coatings from several different basis metals and nonmetallic substrates. Several examples are given in Table 1.

With the advent of stricter regulations governing hazardous and waste material treatment and disposal, and with the increasing concern for worker exposure to toxic chemicals, new noncyanide stripping formulations and processes are being investigated and used. Many of these are acidic or basic solutions that may or may not contain other additives; several were formulated on an empirical basis. The chemistry of metals exposed to most mineral acids, inorganic bases, ammonia, cyanide, and water has been known for years, and this data base of information has resulted in development of the most currently used strippers and processes. In most instances where noncyanide strippers can be used, they are. Several obstacles have precluded the research necessary to develop new noncyanide strippers; however, significant advances in this technology in the last 10 years have resulted in several commercial formulations becoming available. The principal effort has been directed at replacing solutions that strip a nickel coating from mild or low alloy steels. This constitutes a large portion of the Air Force's applications, although applications involving smaller amounts of other metals have not received equal attention.

Several of the noncyanide strippers that have been developed for some of the specific plate metal/basis metal combinations listed in Table 1 are being used in large-scale industrial electroplating facilities. The Air Force could benefit if these new technologies are implemented into the ALC electroplating shops--noncyanide solutions are less toxic, more susceptible to biodegradation, and more easily decomposed by chemical processes. In other words, the noncyanide solutions would present less hazard to workers and to the environment without compromising quality and efficiency in production.

TABLE 1. SURFACE COATINGS REMOVED BY CYANIDE STRIPPERS AND BASIS MATERIALS FROM WHICH THE COATINGS ARE REMOVED (FROM T.O.42C2-1-7)

Surface Coating	Basis Material
Brass	Low-Alloy Steels
Bronze	Low-Alloy Steels
Cadmium	Low-Alloy Steels High-Strength Steels
Copper	Low-Alloy Steels
Gold	Low-Alloy Steels Nickel-Base Alloys Copper and Copper Alloys Stainless Steels Numerous Plastics Numerous Glasses
Nickel-Cadmium	Low-Alloy Steels
Electrolytic Nickel	Low-Alloy Steels
Electroless Nickel	Low-Alloy Steels Titanium Alloys
Silver	Nickel-Base Alloys Low-Alloy Steels Stainless Steels Numerous Plastics Numerous Glasses Copper and Copper Alloys
Tin	Low-Alloy Steels
Tin-Cadmium	Low-Alloy Steels
Titanium-Cadmium	Low-Alloy Steels
Tungsten-Carbide	Low-Alloy Steels
Zinc	Low-Alloy Steels

C. SCOPE

The program is composed of three phases that will run for about 1 year each. Phase I activities involve gathering and organizing information on cyanide and noncyanide strippers and running laboratory-scale performance tests on coupons representative of materials used at Kelly AFB. Phase II will involve testing noncyanide strippers (those that performed well in Phase I) on aircraft parts in a pilot-scale facility at Kelly AFB. Also in Phase II, laboratory investigations leading to the development of noncyanide strippers for high volume and precious metal coatings will begin. In Phase III, three concurrent activities will be conducted: (a) the noncyanide processes found to be acceptable in the pilot scale tests will be implemented in the Kelly AFB stripping line, (b) pilot-scale tests of strippers developed in Phase II will be conducted for comparative evaluation, and (c) research will continue in developing new noncyanide formulations for applications where commercial processes do not exist.

In Phase I, information concerning cyanide and noncyanide electroplating, stripping and cleaning solutions, and processes was gathered and incorporated into a data base. This information includes the names of companies supplying noncyanide strippers, the product name, and the product applications. Additional information includes the manufacturer's Technical Bulletin (TB) describing the use and performance characteristics of the product, and the Materials Safety Data Sheet (MSDS) describing the safety considerations necessary for the safe use of the product. Other information includes the raw data obtained from the laboratory tests with coupons and stripping solutions along with the determined stripping rates and the degree of biodegradability. The experimental tests were conducted at the Idaho National Engineering Laboratory (INEL) and are described in detail in the Procedures section. The Technical Bulletins and MSDS sheets contained in the Data Base have been reprinted and are shown in Appendix A.

Phase II activities will begin in the second year; field verification tests will be conducted at Kelly AFB. These tests will be similar to the Phase I tests, but scaled up to be comparable with process equipment already

used in the Kelly AFB electroplating shop. Noncyanide formulations and processes tested in Phase I found to have good performance characteristics will be tested in this phase. Alternative equipment called for by the manufacturer will be tested as well. The inherent differences between the nonvolatile cyanide salt solutions and the more volatile noncyanide molecular solutions require minor modifications to some of the process equipment used at Kelly AFB. Aircraft parts will be used for all of the processes tested. Processes tested on this scale and found to meet military specifications and Air Force needs will be ready for immediate transfer to process lines.

Laboratory investigations in Phase II will examine the fundamental mechanisms involved in stripping processes. The purpose is to examine the behavior of metal surfaces and ions in the presence of potentially useful alternative solvents, ligands, chelating agents, and known surface passivation agents. The alternative reagents will be composed of inexpensive compounds that have considerable potential as stripping agents. Some of these compounds have been studied by the electroplating and mining industries with good results, and are available as proprietary formulations from the respective companies. The advantages from this study are twofold: (1) formulations specific to Air Force applications will be developed, and (2) the cost of using the formulations will be low since the ingredients will be known and can be purchased individually in bulk quantities.

In addition, the Air Force has some specific stripping applications such as silver, that have not been successfully demonstrated in the commercial sector. Laboratory work in Phase II will also be directed at examining the synergy between precious metal stripping and recovery, recognizing that a suitable noncyanide precious metal stripping process must be accompanied by a recovery process. Noncyanide formulations will be developed in Phase II for silver and gold stripping, and corresponding recovery methods will be investigated. Recovery methods will be investigated for the new formulations and also for existing noncyanide strippers with other applications since some of them are effective silver strippers.

In Phase III, three concurrent activities will be conducted: (a) the noncyanide processes found to be acceptable in the pilot scale tests will be implemented in the Kelly AFB stripping line, (b) pilot-scale tests of strippers developed in Phase II will be conducted for comparative evaluation, and (c) research will continue on developing new noncyanide formulations for applications where commercial processes do not exist.

The major activity in Phase III will be to implement acceptable new noncyanide stripping processes that were tested on aircraft parts in Phase II. The technology should transfer easily since the pilot-scale tests will be conducted with equipment similar in size, configuration, construction, and materials to that used in the Kelly AFB electroplating shop. The choice between several equivalent processes may be possible for some of the applications because several formulations already exist, thus affording the opportunity for comparative planning. Pilot-scale testing of new, potentially useful noncyanide strippers will continue on an as-needed basis. This will ensure that the most recently developed technologies can be considered for implementation. Work on developing new noncyanide strippers will continue if acceptable formulations and processes have not become available by that time.

SECTION II
RATIONALE AND METHODOLOGY

There are two technical reasons for using cyanide in stripping solutions. First, cyanide has the ability to change the electrochemical behavior of several metals, allowing them to be oxidized and thus, more easily stripped. Second, cyanide is a strong complexing agent that readily binds to the oxidized surface species and solvates them. The dissolution of metal occurs after the exposed surface has been oxidized from the zero valence state to a higher valence state. When a solvent can solvate the oxidized species, a fresh metallic surface is then exposed and oxidized. Thus, a cycle is established wherein a clean metallic surface is repeatedly oxidized and dissolved. In developing noncyanide strippers, the electrochemical and solvating characteristics of the constituents must be carefully considered.

Stripping performance was determined for the plate/surface coating materials: cadmium, indium, lead, nickel, silver, tungsten-carbide, chromium, copper, and tin. Early reports from the information-gathering task indicated that these are the primary coatings stripped from basis metals by cyanide strippers. The effect of the stripper solutions on basis metal stripping and pitting was determined for braze materials, low alloy steels, and heat and corrosion resistant steels. Additional tests were performed on three masking materials routinely used in the ALC plating shops: Petrolyte Amber Bee Squared 175 masking wax, a toluene-soluble polymer (Organosol), and a high temperature melting polymer (Mask Peel B-100).

The materials were tested within the acceptable range of conditions used in the electroplating shop. Temperatures ranged from ambient temperature to 130°F. Processes that work acceptably at lower temperatures were emphasized because of worker safety considerations. Additionally, air or mechanical agitation and conventional ventilation systems representative of Air Force facilities were used to determine if special ventilation and agitation systems will be necessary to implement the new technologies.

Biodegradability characteristics were evaluated to determine if existing biological waste treatment facilities are adequate to reduce harmful effluents to below National Pollution Discharge Elimination System (NPDES) limits. The existing ALC waste treatment facilities vary in design, capability, and capacity. They are primarily designed for handling dilute waste streams from which heavy metals are precipitated and any organics are decomposed in an activated sludge complex. The current method of drumming concentrated stripping wastes for disposal will not be acceptable in the future because of increased economic, safety, and long-term liability considerations. If the current method of treating dilute aqueous waste streams can be expanded to include stripping wastes, significant economic and safety benefits can be realized.

A list of recently developed noncyanide strippers and their applications was collected and is presented in Table 2. These are commercially available, claim to meet many of the performance criteria established by the Air Force, and are reportedly capable of meeting Air Force needs.

It appears that, with two exceptions, at least one noncyanide product exists for every stripping application at Kelly AFB (see Table 3). Many of the products listed in Table 2 can be tested on Air Force applications and then incorporated into the stripping line. The exceptions are for silver and gold stripping; suitable procedures do not exist for recovering these metals from noncyanide strippers. Since silver and gold are precious metals and the Air Force does not recover them directly, commercially competitive recovery processes must be used. The task of developing noncyanide silver and gold strippers is therefore, twofold--the strippers must be technically and functionally acceptable, and recovery processes must be developed simultaneously.

The essence of the program is involved in two priority activities with a common goal. The first-priority activity is to test and implement commercial noncyanide stripping processes in the Kelly AFB electroplating shop. The second-priority activity is to develop, test, and implement new noncyanide stripping processes for applications for which no satisfactory process exists. The common goal is to remove all cyanide solutions and cyanide wastes generated in the stripping lines at Kelly AFB.

TABLE 2. PRODUCT LIST OF COMMERCIAL NONCYANIDE STRIPPERS

Company Name	Product	Surface Coating	Basis Material
Circuit Chem. Corp.	Cirstrip NCN-SCB	Nickel and electroless coatings	Steel, Copper, Brass
Circuit Chem. Corp.	Cirstrip NCN-CU A,B	Copper	Steel
E&G Equip. & Chem.	Stripper 3121		
E&G Equip. & Chem.	Stripper 210		
E&G Equip. & Chem.	Stripper 200		
Electrochemicals	Nickel-Sol	Nickel, Copper	Aluminum, Plastics, Stainless Steels
Electrochemicals	Electrostrip S. A.	Copper, Nickel, Chromium Cadmium, Tin, Silver	Mild Steels, Titanium
Enthone, Inc.	Entstrip EN-79	Electroless Nickel	Steel, Copper Alloys
Enthone, Inc.	Entstrip S-180	Nickel-Iron, Nickel, Copper, Nickel Sulfamate	Steel
Enthone, Inc.	Entstrip C-38	Copper	Steel
Enthone, Inc.	Entstrip TL-143		
Frederick Gumm Chem.	Clepo Electrostrip B/C	Nickel, Copper, Chromium, Zinc, Cadmium	Steel
Frederick Gumm Chem.	Clepo 204 (Immersion)	Nickel, Electroless Nickel	Mild Steel
Kiesow Int'l Corp.	Nickel Stripper ST	Copper, Nickel, Brass, Cadmium, Tin	Steel
MacDermid Inc.	Metex Metal Stripper SS no. 2, no. 3603	All commercial electroplated coatings except Heavy Chromium, and precious metals	Stainless Steel Aluminum
MacDermid Inc.	Metex Nickel Stripper SCB	Nickel	Steel
MacDermid Inc.	Metex Silver Stripper CB no. 4001	Silver	Copper, Brass, Copper Alloys
Metalline Chem. Corp.	K 72 (Tin)	Tin, Tin-Lead	Ferrous, Copper
Metalline Chem. Corp.	6400 (Nickel)	Nickel	Steel
Metalline Chem. Corp.	Zinc Stripper W	Zinc	Steel, Copper, Brass
OMI Int'l Corp.	Udystrip 6000	Bright Nickel, Semi-bright Nickel, Electroless	Steel

TABLE 2. PRODUCT LIST OF COMMERCIAL NONCYANIDE STRIPPERS (Concluded)

OMI Int'l Corp.	Udystrip 406	Bright Nickel, Semi-bright Nickel	Copper, Brass
OMI Int'l Corp.	Udystrip 460	Bright Nickel, Semi-bright Nickel	Steel, Brazed Steel
OMI Int'l Corp.	Udystrip XPS-306	Bright Nickel, Semi-bright Nickel, Ferro-Nickel, Watts Nickel	Steel
Oakite Products, Inc.	Oakite 32 (HCl sol)		
Oakite Products, Inc.	Stripper N-3		
Patclin	Patstrip Ni-E	Nickel, Electroless Nickel, Copper, Chromium, Zinc, Cadmium	Steel
Patclin	Patstrip NiX-85	Nickel	Copper, Steel, Copper Alloys
Patclin	Patstrip Ni	Nickel	Brass, Copper Alloys Copper
Patclin	Dip N Strip III	Nickel, Copper, Electroless Nickel	Steel
Shipley Co., Inc.	Nickel Stripper 424	Nickel	
Shipley Co., Inc.	Niposit 428	Nickel	
Witco Corp.	ARP-66	Electroless Nickel	Iron based Alloys
Witco Corp.	ARP-60	Copper, Nickel, Cadmium, Zinc, Silver, Tin	Iron, Steel

TABLE 3. NONCYANIDE STRIPPING PROCESSES USED AT KELLY AFB

Plate Metal	Basis Metal	Stripper	Conditions
Electrolytic Nickel	Low Alloy Steels	C-106, Sodium Meta Nitro Benzene Sulfonate	Immersion, 120-130^{0}F
		Reservol Proxide	1280 lbs (McKessen Chemical)
		Sodium Hydroxide	320 lbs
		Sodium Cyanide	1920 lbs 2560 gal total solution
Electroless Nickel	Low Alloy Steels	C-106, Sodium Meta Nitro Benzene Sulfonate	Immersion, 120-130^{0}F
		Reservol Proxide	1280 lbs (McKessen Chemical)
		Sodium Hydroxide	320 lbs
		Sodium Cyanide	1920 lbs 2560 gal total solution
Silver	Low Alloy Steels	C-101	2-4 volts anodic, 68-77^{0}F
		Sodium Hydroxide	2 oz/gal
		Sodium Cyanide	12 oz/gal
		Alt C-106	Immersion, 120-130^{0}F
		Sodium Meta Nitro Benzene Sulfonate	
		Reservol Proxide	1280 lbs (McKessen Chemical)
		Sodium Hydroxide	320 lbs
		Sodium Cyanide	1920 lbs 2560 gal total solution
		Alt C-107	2-4 volts anodic, 120-140^{0}F
		Trisodium Phosphate	6 oz/gal
		Sodium Hydroxide	1 oz/gal
		Sodium Cyanide	16 oz/gal

TABLE 3. NONCYANIDE STRIPPING PROCESSES USED AT KELLY AFB (Continued)

Plate Metal	Basis Metal	Stripper	Conditions
Cadmium	Low Alloy Steels	C-102	Immersion, ambient
		Ammonium Nitrate	Immersion, 900 lbs/900 gal solution, amb temp
		Alt C-106	Immersion, 120-130^{0}F
		Sodium Meta Nitro	
		Benzene Sulfonate	
		Reservol Proxide	1280 lbs (McKessen Chemical)
		Sodium Hydroxide	320 lbs
		Sodium Cyanide	1920 lbs 2560 gal total solution
Nickel-Cadmium	Low Alloy Steels	C-106	Immersion, 120-130^{0}F
		Sodium Meta Nitro	
		Benzene Sulfonate	16 oz/gal
		Sodium Hydroxide	6 oz/gal
Lead	Low Alloy Steels	C-109	2-4 volts anodic, amb-120^{0}F
		Sodium Hydroxide	12 oz/gal
		Alt C-113	Immersion, 120-130^{0}F
		Sodium Meta Nitro	
		Benzene Sulfonate	16 oz/gal
		Sodium Hydroxide	6 oz/gal

TABLE 3. NONCYANIDE STRIPPING PROCESSES USED AT KELLY AFB (Concluded)

Plate Metal	Basis Metal	Stripper	Conditions
Lead (continued)	Used at Kelly but not in the T.O. for this application	Sodium Meta Nitro Benzene Sulfonate	
		Reservol Proxide Sodium Hydroxide Sodium Cyanide	1280 lbs (McKessen Chemical) 320 lbs 1920 lbs 2560 gal total solution Immersion, 120-130^{o}F
Indium	Application Unknown	Sodium Meta Nitro Benzene Sulfonate	Immersion, 120-130^{o}F
		Reservol Proxide Sodium Hydroxide Sodium Cyanide	1280 lbs (McKessen Chemical) 320 lbs 1920 lbs 2560 gal total solution
Tungsten-Carbide	Application Unknown	Reservol Proxide Sodium Cyanide Entstrip TL Sodium Hydroxide	270 lbs 400 lbs 535 lbs 400 lbs 538 gal total solution Immersion, 120-130^{o}F
Gold	Application Unknown	Sodium Cyanide Base	Unknown
Copper	Application Unknown	Sodium Cyanide Base	Unknown

SECTION III
PROCEDURES

A. EXPERIMENTAL APPARATUS

The experimental apparatus consists of reactor assemblies, temperature controlled circulating water baths, and power supplies with current coupling connectors (when electrolytic strippers are used). The reactor assembly consists of a reactor vessel, an exhaust port condenser, and a coupon support assembly (Figure 1). The reactor vessel is a borosilicate glass vessel made from constant-diameter, standard-taper, ground glass joint blanks.

The reactor's diameter is roughly 2-1/4 inches (57 mm) and its overall height is about 7-7/8 inches (20 cm). The coupons can be suspended in the barrel of the reactor with about 1 inch (25.4 mm) separating them and 1/4 to 1/2 inch (6.4 to 12.7 mm) gap to the wall. The coupon support assembly consists of a machined Teflon disc, made to seal in the standard taper joint, which has two support hangers suspended from the underside of the disc. Electrical connection is made from these support hangers through the disc to standard electrical connectors on the upper side of the disc.

A single coupon of the test material to be evaluated (the test coupon) was suspended from one support. With immersion strippers, a stainless steel coupon of equal surface area was suspended from the other support. Passivated stainless steel coupons ("dummy" coupons) were used in conjunction with test coupons made from basis materials. A jumper wire was connected across the terminals outside the cell to simulate or create galvanic effects present in the larger-scale production stripping tanks where more than one type of metal on a part can be exposed to the solution. When testing electrolytic strippers, the dummy coupon material was stainless steel and constituted the counter electrode or cathode in the electrolytic cell. The external electrical connectors were connected to a DC regulated power supply.

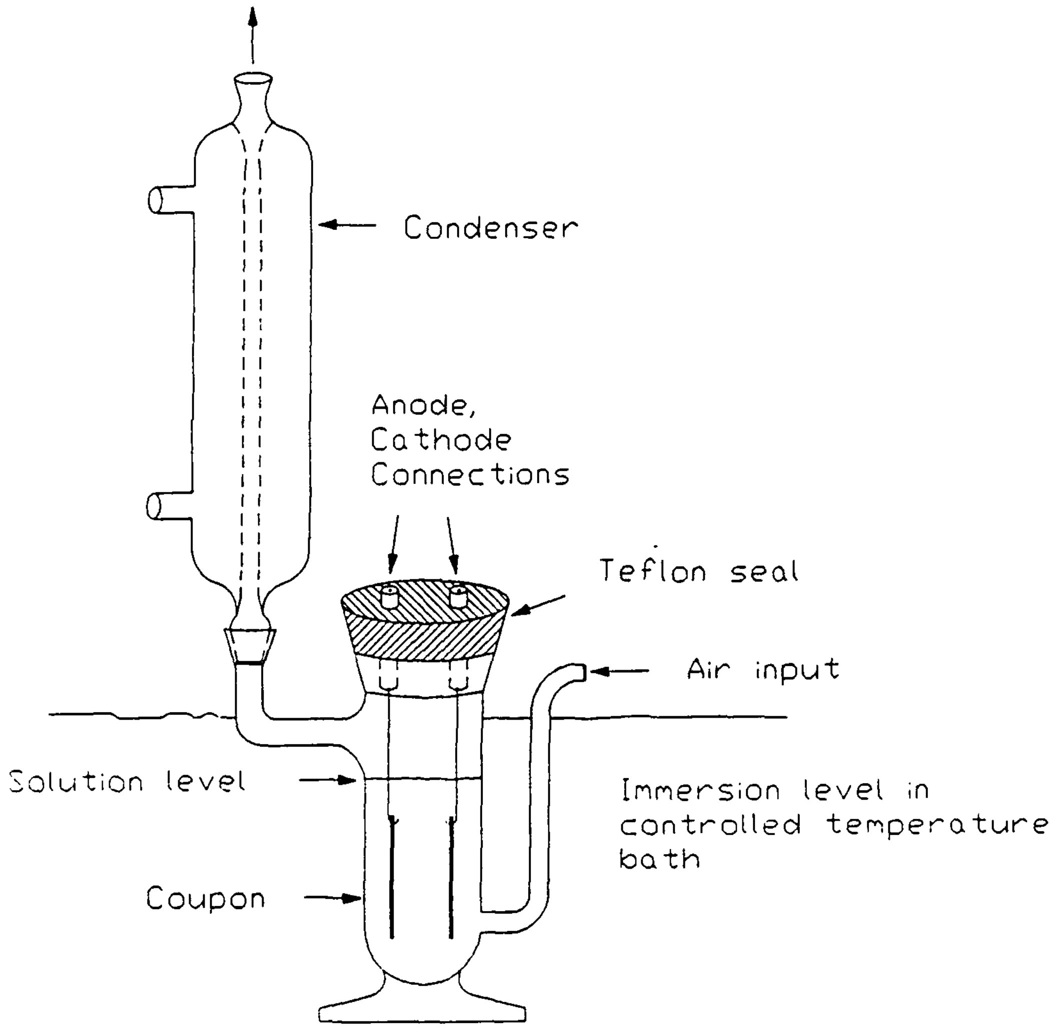

Figure 1. Noncyanide Stripping Test Vessel.

During operation, air is passed through two openings in the reactor. Air enters the reactor through the tube indicated on the right side of Figure 1. Exhaust gases exit through the exhaust port condenser, which retains solvent during the reaction. The air serves two purposes and is used to different extents depending on the type of stripper being tested--solvent oxygenation and mechanical agitation are both achieved by flushing the reactor with air (a procedure used extensively in the Kelly AFB electroplating shop for cyanide solutions). For solutions containing volatile components, mechanical agitation was provided by placing the reactors on a submersible stirring plate. Teflon coated stir bars in the reactors stirred the solutions.

The desired voltage/current relationship on the coupons was achieved by connecting a regulated power supply to a buss bar similar to those used in the electroplating shop at Kelly AFB. Leads from the buss bar were connected in parallel to each reactor assembly. The current flow is regulated by the solution resistance while the applied stripping potential remains constant and equal over all of the samples run. Up to six reactor vessels were accommodated in the baths at a time.

The temperature-controlled circulating water baths serve as constant temperature baths for the reactors. Temperature equilibration with the reactors is quick, and local hot spots are eliminated because of constant mixing.

B. MATERIALS TESTED

A list of the coupon materials and their elemental analyses are given in Table 4. Analyses are from Metal Samples, Inc., from whom the coupons were purchased.

TABLE 4. COUPON ANALYSES

Aluminum, Al 1100
Al-98.65%, Si+Fe-1.0 max, Cu-0.05/0.20, Mn-0.05, Zn-0.10, others-0.15.

Bronze, Fuming

Cadmium
Cd-99.95%, Al-As-Fe-Sn-Zn-<0.001% each, Sb-0.0005, Cu-0.0006, Pb-0.0024, Ag-0.0017

Chromium
Cr-99.943%, Ag-B-Ca-Co-Cu-Mg-Mn-<0.0001 each, Fe-0.01, Si-0.04

Copper, CDA 101
Cu-99.99%

Hastelloy C276
Ni-57.71%; Mo-15.63, Cr-15.54, Fe-5.77, W-3.80, Co-1.33, V-0.17, Si-0.03, P-0.015, C-0.003, S-0.002

Hastelloy X
Ni-47.79%; Cr-21.8, Fe-18.19, Mo-9.01, Co-1.16, Mn-0.61, W-0.58, Si-0.40, Cu-0.26, Al-0.11, C-0.07, Ti-0.01, P-0.01, B-S-0.001

Inconel 625
Ni-60.20%, Cr-22.34, Mo-8.48, Fe-4.53, Cb+Ta-3.51, Si-0.34, Ti-0.25, Mn-0.16, Al-0.14, C-0.04, P-0.01, S-0.001

Indium
In-99.999%

Lead: Pb-meets specification of lead (assume pure lead, Pb-99.999%)

Nickel, Ni 200
Ni-99.72%; Mn-0.20, Si-0.04, Fe-0.02, C-Cu-0.01, S-0.001

Silver
Ag-99.9%

Steel (CAS) C4340
Fe-95.73%, Ni-1.68, Cr-0.85, Mn-0.80, C-0.40, Mo-0.23, Si-0.22, Cu-0.06, P-0.015, S-0.012

Steel (CAS) A286
Fe-55.72%; Ni-25.03, Cr-14.98, Ti-2.11, Mo-1.24, V-0.310, Al-Si-0.19, Mn-0.16, C-0.038, P-0.017, B-0.0071, S-0.003

Steel (CAS) 9310
Fe-94.27%; Ni-3.26, Cr-1.34, Mn-0.52, Si-0.28, Mo-0.11, C-0.10, Cu-0.06, Al-0.05, Sn-0.006, Ti-0.003, S-0.002, B-<0.0005

TABLE 4. COUPON ANALYSES (Concluded)

Steel (CAS) 8740
Fe-97.61%; Mn-0.90, Ni-0.46, Cr-C-0.42, Si-0.27, Mo-0.22, Cu-0.09, S-0.021, P-0.011

Steel (HCRS) 17-4 PH
Fe-74.89%; Cr-15.58, Ni-4.12, Cu-3.29, Mn-0.80, Si-0.57, Cb-0.23, Co-0.07, Mo-0.06, C-0.36, P-0.016, S-0.008

Steel (HCRS) 309 ss
Fe-59.94%; Cr-22.30, Ni-14.86, Mn-1.80, Si-0.54, Cu-0.25, Mo-0.16, Co-0.05, N-0.041, C-0.033, P-0.026, S-0.003, B-0.0009

Steel (HCRS) 316 ss
Fe-69.53%; Cr-17.15, Ni-10.04, Mo-2.06, Mn-0.44, Si-0.31, Co-0.21, Cu-0.12, C-0.054, N-0.047, P-0.022, S-0.016

Steel (HCRS) 410 ss
Fe-85.61%; Cr-12.24, Mn-0.71, Si-0.50, Ni-0.34, Mo-0.30, C-0.127, Cu-0.08, N-0.041, Co-P-0.02, Al-0.011, Sn-0.006

Tin
Sn-99.925%; Pb-0.032, As-0.025, Fe-0.005, Cu-Bi-0.004, Sb-0.003, Co+Ni-0.002, S-trace

Tungsten-Carbide
W Carbide-93.5%; Co-6.0, Ta Carbide -0.5, C(total)-5.81, C(free)--.06

C. PREPARATION OF STRIPPER SOLUTIONS

Three categories of stripper solutions were prepared in this study: commercial noncyanide formulations, generic formulations not containing cyanide, and generic formulations containing cyanide.

The commercial noncyanide formulations were prepared according to the manufacturer's specifications as given in the Technical Bulletin or Product Information Sheet which accompanies each product (see Appendix A). These were generally a one-component mixture in water or two-component mixtures of proprietary ingredients. The generic formulations, containing or not containing cyanide, were mixed according to information obtained from the Operating Technical Order T.O. 42C2-1-7.

D. GENERAL LABORATORY PROCEDURE

A general procedure for conducting the laboratory tests is given here, and specific procedures referred to are described later.

Aliquots of 120 to 180 milliliters of the stripping solution were placed in the reactor vessels. Coupons were selected to be compatible with the stripper application and hung on supports connected to the reactor top. Before testing, these coupons were degreased, weighed, and the surface of the coupon was characterized. The reactor tops with suspended coupons were lowered into the reactor vessels with a small stir bar and the tops were sealed. The reactor vessels were then placed into the temperature-controlled circulating water baths on top of submersible stirring plates. The temperature was maintained at a value determined from the manufacturer's recommendations or from T.O. 42C2-1-7. A temperature of 130°F was not exceeded in any of the tests because higher temperatures pose a safety problem and because initial tests were directed at finding strippers that were effective under nonhazardous conditions.

Because there are two basic types of strippers, immersion strippers and electrolytic strippers, a coupon and a counter electrode (usually a stainless steel inert electrode) were both suspended in the reactor from separate supports to which electrical connections were later made.

The air hoses were connected to the air inlet tube and the condensers were inserted into the exhaust ports. Air and/or mechanical agitation was started by turning on the air supply and/or the magnetic stir plates. A timer was set and the stripping reactions were allowed to proceed. If an immersion stripper was being tested, a jumper wire was connected across the supports. If an electrolytic stripper was being tested, alternative connections were made from the buss bar to the coupon and cathode material, respectively. In all cases where an immersion stripper was tested, the counter-electrode material was stainless steel opposite plate materials and passivated stainless steel opposite basis materials (Reference 4). The counter electrode material used in electrolytic tests was made of stainless steel. The power supply was then turned on and the voltage and current were alternately adjusted in small increments to the recommended values.

The reactions were allowed to proceed until visible signs of extensive dissolution were observed or until six hours had elapsed. Basis materials were allowed to remain in solution for 24 hours.

At this time, the power supply was turned off and the electrical wires disconnected (for tests with electrolytic strippers). The air lines and condensers were also disconnected and the reactors were removed from the water bath. The time was noted before proceeding. The reactor tops were individually lifted from the seated position and the underside of the reactor tops were rinsed, along with the supports and coupons, with deionized water.

Care was taken to capture all of the rinse water in the reactor vessel. The coupons were then cleaned, according to the corrosion procedure given later, and placed in a drying oven at 212°C (100°F) for up to 15 minutes. Meanwhile, the solution was poured from the reactor into a 200-milliliter volumetric flask, along with deionized water. These solutions were later used for atomic absorption, ultraviolet and visible spectrometric, and polarographic analyses.

After drying, the coupons were removed from the oven and placed in a desiccator to cool, then weighed and the mass loss and stripping rate were calculated. The surface was again characterized and changes were noted.

If surface changes occurred, the coupons were refurbished before using them in later tests. If a coupon had thick deposits, scale, or other coatings, it was cleaned after the coated surface was characterized, then the metal surface was characterized.

The masking materials were tested for compatibility with the strippers by observing changes in their physical behavior in the solutions over a temperature range from ambient to about 90°C (194°F). A small piece of masking material was added to a test tube containing 5 to 15 mL of stripper at ambient temperatures. A thermometer was inserted into the test tube to record the temperature and aid in stirring. The test tube

containing the solution, maskant, and thermometer were immersed in a boiling water bath. As the temperature of the stripping solution increased, observable changes in the properties of the masking materials were recorded.

1. Corrosivity Determination

The purpose of this task was to determine the corrosion or dissolution behavior of metal coupons in commercial noncyanide strippers. The coupons were cleaned according to the ANSI/ASTM 483-77 procedure (Reference 5). The new metal coupons were cleaned by dipping in 1,1,1-trichloroethane maintained at 65°C and wiped with paper towels to remove excess solvent. They were then dipped in methyl ethyl ketone at room temperature, wiped dry, and dried in an oven for 15 minutes. The coupons were weighed to the nearest 0.1 milligram and hung on the support rod of the reactor vessels for testing. Metals for which the strippers were recommended were tested along with other metal coupons and some made of masking materials. The samples were tested in the apparatus shown in Figure 1 for periods of up to 24 hours in the stripping solutions at the recommended concentration and temperature. After this time, the coupons were cleaned by scrubbing with a soft bristle brush under running hot water, rinsed with distilled water, and then rinsed with acetone. The excess acetone was removed by wiping with a paper towel and the coupon was dried for 15 minutes in a lab oven at 38°C (100°F), weighed, and stored in a desiccator. If any scale was present on the coupons, they were acid-cleaned according to the acid-cleaning procedure for the respective metal (ANSI/ASTM 483-77) and then reweighed. The appearance of the coupons was recorded after removing from the stripper and after scrubbing under water, and again after acid cleaning. The cleaned coupons were examined under a microscope at 400 X for pits and surface attack (Reference 6). Two or three coupons of each metal were tested in each stripper.

2. Coupon Refurbishing

Several of the coupons were reused in the stripper reactions. If no changes in the surface characteristics were observed, the coupons were recycled through the cleaning process described previously in this section.

If physical changes were evident but not severe, the coupons were refurbished. This involved sanding the surfaces with 20-grit sandpaper until all signs of aberrations were removed. The coupons were then cycled through the degreasing procedure and stored in the desiccator without further treatment until used in subsequent runs.

3. Stripping Rate Calculations

The stripping rates were calculated from mass loss data according to the equation: $SR = Xm\left(\frac{1}{D}\right)\left(\frac{1}{S.A.}\right)\left(\frac{1}{t}\right)\left(\frac{1000\ \text{mils}}{2.54\ \text{cm}}\right)$

where SR is the stripping rate in mils/hours, χm is the mass change in grams for the coupon, D is the density of the coupon material in g/cm^3, S.A. is the surface area of the coupon in cm^2, and t is the time in hours for which the coupon was exposed to the stripping solution. The surface areas of the coupons were calculated based on the physical dimensions of new coupons. For example: A coupon of nickel (N200) has the dimensions 1 by 2 by 1/8 inches with a 1/4-inch hole bored through it. The surface area (SA) is equal to

$$SA = [2x(FA + TE + SE - HFA) + HE]\left(\frac{2.54\ \text{cm}}{1\ \text{in.}}\right)^2$$

where FA is the face area (2 $in.^2$), TE is the top edge area (1/8 $in.^2$), SE is the side edge area (1/4 $in.^2$), HE is the exposed edge of the bored hole (0.098 $in.^2$), and HFA is the area missing from the coupon face due to the bored hole (0.049 $in.^2$).

Thus, the SA for a 1/8-in. coupon is 30.65 cm^2 or 4.75 $in.^2$. The values for 1/16 and 1/4-inch coupons were calculated similarly and are given in Appendix B. Coupons of the bronze were not available. Commercial, fuming bronze, braze rods were used. The lengths are given in Appendix B

for rods with a diameter of 0.093 inch. The areas of these coupons were calculated as:

$$SA = 2\pi r(r + l)$$

where r is the radius of the rods and l is the length of the rods. Some copper wire coupons were also used. These also had a diameter of 0.093 inch. Hence, the surface areas of these coupons were calculated similarly.

4. Biodegradability Assessment

Biodegradability was assessed by mixing stripper solutions with a maintained bioculture and monitoring the chemical oxygen demand (COD) of the resulting mixture. The bioculture was composed of activated sludge from the Tinker AFB IWTP and a nutrient solution described in Appendix B. Activated sludge from Tinker AFB was used because we could maintain the integrity of all of the samples delivered to the INEL. Because of other field test facilities located at Tinker AFB and operated by INEL personnel, the condition of the sludge and history of the sludge could be continuously monitored with ease while routine collection and preparation for shipping could be conducted.

Samples of each stripper component were mixed to the concentration recommended by the manufacturer. If the stripper was a multicomponent product, the individual components were mixed with only water so that if the stripper did not biodegrade, the chemicals responsible could be more easily identified. The chemical oxygen demand (COD) was determined for these solutions. If the COD value was less than 45,000 ppm, the solution was not tested further for biodegradability. This is because a 1:600 dilution would yield a COD value of less than 150 ppm. The dilution factor is representative of what would occur at Tinker AFB upon dumping a stripping tank into the IWTP Equalization Tank. The 150 ppm value for COD is the imposed NPDES limit at Tinker AFB. If the COD value was greater than 45,000 ppm, the solution was tested for biodegradability.

To evaluate biodegradability, 12 small columns (Figure 2) were fabricated. These columns used air diffusion for solids suspension, which closely represents those of the treatment system used at Tinker AFB. The test solutions were diluted 1:600 with the nutrient medium described in Appendix B. This dilution represents the concentrations that might be expected at the IWTP (Industrial Waste Treatment Plant) during normal operation. The test columns were filled to a total volume of 250 milliliters (225 milliliters of solvent and basic nutrient medium and 25 milliliters of culture column microorganisms). A control was used to compare the COD of the solvent to that of the phenol, on which the culture is maintained. For each test column, two samples were taken every hour for 6 hours. A split, infiltrate sample was taken during each test to determine if the chemicals that affect COD were being adsorbed on the biomass. COD was determined on each sample and plotted against time. An adenosine triphosphate (ATP) measure of each column was also taken at the beginning and end of each test to determine if the solvents changed the biomass. ATP was determined with a Turner Design ATP Photometer calibrated with the internal standard procedure provided with the instruments.

The stripper solutions were analyzed for COD and total organic carbon (TOC) before any biodegradation of the stripper solution. The TOC provides a measure of comparison to indicate the proportion of the COD that can be attributed to the organic carbon present in the solvents. TOC was analyzed using an O. I. Corporation Total Carbon Analyzer and the direct injection procedure provided with the instrument. COD was measured using HACH COD reactors and HACH prepackaged COD reagents. The concentrations were read with a HACH DR3000 Spectrophotometer. To ensure a consistent correlation of biomass to solvent/sample ratio, the dry weight of the activated sludge was determined for each set of tests; the mixed liquor suspended solids (settling rate) was also determined.

A review of the literature and manufacturing information indicated that several methods are available for determining the biodegradability of chemicals, and there are several definitions of biodegradability. For this project, solvents that can be biologically degraded to NPDES discharge

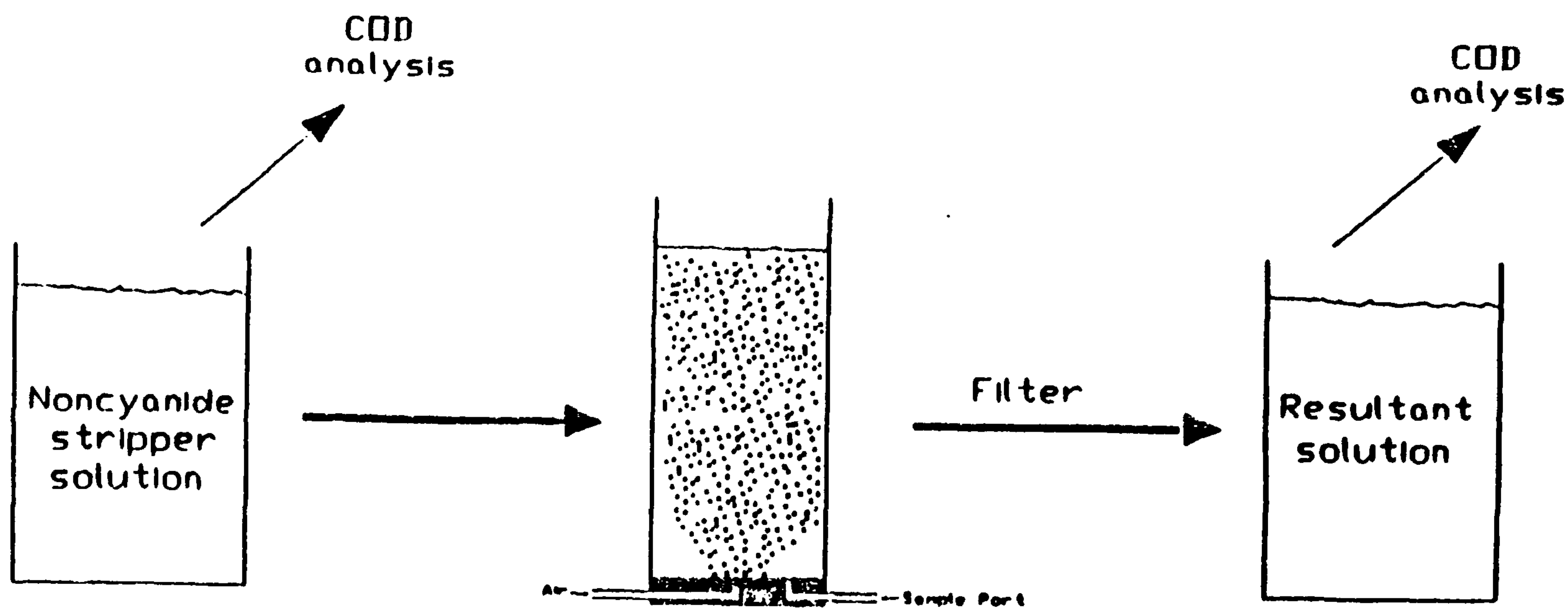

Figure 2. Biodegradability Test Reactor.

limits by the activated sludge treatment system at the IWTP were considered biodegradable. The limit imposed at Tinker AFB is 150 ppm for COD. A modification of ASTM's standard test method for Biodegradability of Alkylbenzene Sulfonates (Designation: D 2667-82, Presumptive Test) was used to screen the biodegradability of the stripper solutions proposed for substitution at Kelly AFB. Protocol changes were made to permit what was believed to be a more direct association of testing conditions to those conditions at the IWTP at Tinker AFB. The detailed protocol followed for this period of testing is outlined in Appendix B. The measure of biodegradability was the ability for microorganisms to remove the solvent or toxic compounds from solution. This was measured as indicated by the decrease in chemical oxygen demand (COD), which is a measure of the concentration of oxidized materials in the waste water that are amenable to chemical oxidation. COD is also a criterion of the Tinker AFB NPDES discharge permit.

A culture of bacteria from Tinker AFB's activated sludge system was maintained in a bench-scale sludge column located in the Idaho National Engineering Laboratory Research Center (IRC), Idaho Falls, Idaho. This culture was used in biodegradation tests of new products proposed for replacing cyanide strippers. The bacteria culture was prepared fresh during each week of testing from samples collected at the Tinker AFB IWTP complex. This procedure was followed to eliminate variations in the culture that can arise through adaptations over extended time periods.

SECTION IV
RESULTS

The results consist of the raw stripping data for the 26 strippers tested and the COD data resulting from the biodegradability tests. The strippers are listed in Table 5 and the stripping data is tabulated in Appendix C. Table 6 shows the results of the biodegradability tests. The coupon surface descriptions characterizing the coupon surfaces after exposure to the strippers is given in Appendix D.

The raw data for the biodegradability tests is given in Appendix E and consists of two plots on a single page for a single stripper component. The upper plot is of the COD vs. time for the stripper and the lower plot is of COD vs. time for the phenol control run, which was performed simultaneously to indicate the behavior of the culture in a known and well characterized system. The measure of biodegradability follows from a decrease in COD for the stripper, which can only occur with a healthy culture as indicated by the phenol control run. An ATP value close to zero indicates a nontoxic effect on the culture. Stripping rate information is also presented for a common stripper in Appendix E. Stripping rate information compiled for a common metal is given in Appendix F.

A performance summary for the strippers is given in Table 7 with the descriptive commentary leading to the results immediately following.

A. CIRCUIT CHEMISTRY CORPORATION PRODUCTS

1. Cirstrip NCN-CU.

This recyclable noncyanide immersion stripper was formulated to strip copper from steel substrates. The stripping rates for copper metal and the copper containing fuming bronze are appreciable at 5 milliinches (mils) per hour. The effect of this stripper on the different basis materials was negligible whether they were low alloy steels or corrosion resistant alloys.

TABLE 5. NONCYANIDE STRIPPERS TESTED IN PHASE I.

COMPANY	PRODUCT
Circuit Chemistry Corp.	Cirstrip NCN-SCB
Circuit Chemistry Corp.	Cirstrip NCN-CU
Electrochemicals Incorp.	Nickel-Sol
Electrochemicals Incorp.	Electrostrip S.A.
Frederick Gumm Chem. Co.	Clepo Elect. B/C
Frederick Gumm Chem. Co.	Clepo 204
Kiesow Int'l	Nickel Stripper ST
MacDermid Inc.	Metex Nickel Strip SCB
MacDermid Inc.	Metex Ag Strip CB
Metalline Chem. Corp.	Stripper 672
Metalline Chem. Corp.	Nickel Stripper 6400
Metalline Chem. Corp.	Zinc Stripper ST-W
OMI Int'l	Oxystrip 6000
OMI Int'l	Udystrip 7000
OMI Int'l	Udystrip 406
OMI Int'l	Udystrip 460
OMI Int'l	Udystrip XPS-306
Patclin Chem. Co.	Patstrip Ni-E
Patclin Chem. Co.	Patstrip NiX-85
Patclin Chem. Co.	Patstrip Ni
Patclin Chem. Co.	Dip N Strip III
Witco Corp.	ARP-66 ARP
Witco Corp.	ARP-60
Generic[1]	Cyanide C-106
Generic[2]	Cyanide C-101
Generic	Nitric Acid

1 USAF Cyanide Stripper, immersion.

2 USAF Cyanide Stripper, electrolytic.

TABLE 6. SUMMARY AND EXTENT OF BIODEGRADABILITY TESTS

NAME	PRODUCT	COMPONENTS	INITIAL COD	6 HOUR TEST
Circuit Chem.	Cirstrip NCN-SCB	NCN SCB-1	65,000	X
		NCNSCB-2	180,000	X
Circuit Chem.	Cirstrip NCN-CU	NCN-CU A	390,000	X
		NCN-CU B	25,000	X
Electrochem.	Nickel-Sol	NICKEL-SOL I	760,000	X
		CPX-II	190,000	X
Electrochem.	Electrostrip S.A.	Electrostrip S	3,500	NT TST
		Electrostrip A	29,000	NT TST
Frederick Gumm	Clepo Elect. B/C	Electrostrip B	5,500	X
		Electrostrip C	85,000	X
Frederick Gumm	Clepo 204	CLEPO 204-N	224,000	X
		CLEPO 204-T	5,500	X
Kiesow Int'l	Nickel Stripper ST	ST	2,500	NT TST
MacDermid	Metex Nickel Strip SCB	SCB A		NT TST
		SCB B	LW COD	NT TST
MacDermid	Metex Ag Strip CB	CB	X	NT TST
Metalline	Stripper 672	672	160,000	X
Metalline	Nickel Stripper 6400	6400	130,500	X
Metalline	Zinc Stripper ST-W	ST-W	9,000	X
OMI Int'l	Oxystrip 6000	6000	76,500	X
OMI Int'l	Udystrip 7000	XP-115A	41,500	X
OMI Int'l	Udystrip 406	406	3,500	X
		408	9,500	X
OMI Int'l	Udystrip 460	460 (50% ED)	203,500	X
		451	7,500	NT TST
OMI Int'l	Udystrip XPS-306	306B	205,000	X
		307A	67,000	X
Patclin	Patstrip Ni-E	Ni-E-2	62,500	X
Patclin	Patstrip NiX-85	Patstrip 72Y	45,000	X
		Patstrip 73W	120,000	X

TABLE 6. SUMMARY AND EXTENT OF BIODEGRADABILITY TESTS (Concluded).

Patclin	Patstrip Ni	Ni-2	30,000	X
Patclin	Dip N Strip III	DIP N	650,000	X
		Ni-2	X	X
Witco Corp.	ARP-66	66-A	90,000	X
		66-B	171,500	X
Witco Corp.	ARP-60	60	128,500	X
Generic	Cyanide C-106	NaCN with Meta-nitrobenzene Sulfonate	NT TST	NT TST
Generic	Cyanide C-101	NaCN	NT TST	NT TST
Generic	Nitric Acid		NT TST	NT TST

LW COD = Initial COD below NPDES limits after the 1:600 volume dilution.

NT TST = Not tested.

TABLE 7. PERFORMANCE SUMMARY FOR THE STRIPPERS

	PLATE METALS										BASIS METALS												BIODEG.	OVERALL
PRODUCT	Bz	Cd	Cr	Cu	In	Pb	Ni	AG	Sn	W-C	Al	HC	HX	1625	C4340	A286	9310	8740	17-4PH	309	316	410		
Cirstrip NCN-SCB	X	X		X		X	X	X	X	X					A	A			X	A			X	--
Cirstrip NCN-CU	A	X	X	A	X	X	X	X	X		A	A	A	A	A	A	A	A	A	A	A	A	A	A
Nickel-Sol	A	A		A			A			A	X				X	A			A	X	A	X	A	A
Electrostrip S.A.		A	A	A	A	A	A	A	A						X	X	X	X					X	--
CLEPO Elect. B/C		A	X	A	X	A	X								X	X	X	X	X				X	--
CLEPO 204	X	A		X	X		A	X	X	A					A	A		A	A				X	--
Nickel Stripper ST		X			A	A	X	A							X	A	X	X	A		A		X	--
Metex Ag Strip CB	X			X			X	A							X				X				X	--
Mtx. Ni Strip SCB	X	A		X	X		X		A	X					A	A	A		A				X	--
Metalline 672 (Sn)	X	X	X	X		X	X		A	X					A		A		A			X	X	--
Metalline 6400 (Ni)	X	X					A								A	A		A					X	--
Zinc Strip ST-W	X	X	X	X	X		X		X	X				X	A		A		A			A	X	--
Oxystrip 6000	A	A	A				A			A	X				X	X	X		X	X		X	X	--
Udystrip 7000	X	A		A			A			X					A		A	A	A	X		A	A	A
Udystrip 406	X	A	X	X			A	X		X					X		X		X			X	X	--
Udystrip 460	X	A		X			X		X	X					A	A	A	A	A	A			X	--
Udystrip XPS-306	X	X		X			A		X	A					A	A	A	A	A	A			X	--
Patstrip Ni-E	A	A	X	A			A			A					X	X	X	X	X			X	X	--
Patstrip NiX-85	X			X			A						A		A	A	A	A	A	A	A	A	X	--
Patstrip Ni	X	A	X	X			A		A	X					A				A	X		X	A	A
Dip N Strip III	X	A		X			X			A					A	A	A	A	A				X	--
Witco ARP-66	X	A		X	X	X	A								A	A	A	A	A	A			X	--
ARP-60 (App. 2)				X	A	X	X	X	A						X	X	X	X					X	--
Cyanide C-106	A	A		A	X	A	A	A		X					A	A	A	A					X	--
Cyanide C-101	A	A		A	X	X	X	A		A					X	X	X	X	X				X	--
Nitric Acid		A		A			A	A	A			A	A	A	A	A	X			A		A	X	--

TABLE 7. PERFORMANCE SUMMARY FOR THE STRIPPERS (concluded)

Al = Aluminum 1100	BZ = Fuming Bronze	Cd = Cadmium
Cr = Chromium	Cu = Copper	HC = Hastelloy C276
HX = Hastelloy X	I625 = Inconel 625	In = Indium
Pb= Lead	Ni = Nickel 200	Ag = Silver
W-C = Tungsten	Sn = Tin	

X Indicates that these tests were performed.

A Indicates that the results are acceptable i.e, passed the rejection criteria.

The biodegradation behavior of the Cirstrip NCN-CU in the activated sludge columns is shown in Appendix E. The measured COD values over the 6 hours of exposure to the bio-culture are less than the maximum allowed COD of 150 ppm. The solution is not biodegradable but has a very low and acceptable COD value at the 1:600 dilution. This stripper performed well under the three criteria evaluated and can be considered for scale-up tests on the following applications:

- Removing copper plate from low-alloy steel substrates.
- Bronze welds from low-alloy steel substrates.
- Copper plate from heat- and corrosion-resistant steels including stainless steels.
- Copper from nickel alloys.
- Bronze from nickel alloys.

2. Nicstrip NCN-SCB

This noncyanide immersion stripper is designed to remove nickel coatings from copper, steel, or brass assemblies. Addition of sodium hydroxide to the solution also makes it suitable for stripping high phosphorous electroless nickel coatings. Solutions were made up according to the second application and tested at 54°C (130°F). Consistent performance for metal groups was not demonstrated; that is, heat- and corrosion-resistant steels exhibited both good and poor protection for different metals in the class. Appreciable stripping rates for plate metals were observed for cadmium and lead coatings only. These, however, are not as high as for some other strippers tested.

The components SCB-1 and SCB-2 were tested separately in the bioreactor columns. Neither demonstrated biodegradability. Part SCB-1 is borderline acceptable with a COD of roughly 150 ppm at the 1:600 dilution. Part SCB-2 has a high COD of 480 ppm and is unacceptable as determined in these tests.

B. ELECTROCHEMICALS, INC.

1. Electrostrip S.A.

This electrolytic stripper is designed to strip copper, nickel, chromium, cadmium, tin, and silver from mild steels and titanium. The solution has an infinite lifetime requiring maintenance additions of the components and occasional removal of the accumulated sludge.

Appreciable stripping rates were observed for the plate metals cadmium, copper, chromium, indium, lead, nickel, silver, and tin. Basis metal protection was not adequate for the mild steels or heat and corrosion resistant steel tested. Test solutions had low initial COD values and were not subsequently tested in the bioreactors.

2. Nickel-Sol Process

The Nickel-Sol Process is a noncyanide immersion strip process for stripping nickel and copper from aluminum, plastic, and stainless steel. It is a hydrogen peroxide-sulfuric acid formulation that can be regenerated indefinitely. Test solutions were made up according to the manufacturer's instructions and tested at 54°C (130°F).

High stripping rates were observed for the bronze, cadmium and copper with moderate rates observed for both nickel and tungsten carbide. These rates are high enough to warrant scale-up testing. The applications, however, are limited to stainless steels and heat- and corrosion-resistant steels.

The components Nickel-Sol I and CPX-II were subjected to the 6-hour biodegradation tests. The results do not indicate any biodegradation; however, the COD's are below the 150 ppm NPDES limit making them acceptable for ALC use.

C. FREDERICK GUMM CHEMICAL COMPANY, INC.

1. CLEPO 204

This is a noncyanide immersion stripper formulated to remove nickel coatings from copper, brass, and steel substrates. The solution can be reactivated upon depletion of the components until nickel saturation occurs, at which time the solution must be discarded and a fresh solution prepared. The test solutions were made up according to the manufacturer's instructions. Due to our imposed safety limit, the reaction temperature was held at 130°F instead of in the 140-to-180°F range suggested.

Cadmium is stripped at a high rate, and bronze, nickel, and tungsten carbide are stripped at a moderate rate of 1/2 mil per hour. The basis metals were protected to the extent that no observable weight loss or surface blemishes were observed after 24 hours exposure to the solutions. The basis metals tested were low-alloy steels and heat- and corrosion-resistant steels.

Biodegradability tests were conducted individually on the two components, Part N and Part T, at a 1:600 dilution of the full strength components. Part N is not biodegradable and has COD values above the minimum acceptable value of 150 ppm. The average COD value over the 6-hour test is around 330 ppm. Part T has an average COD of around 150 ppm at the 1:600 dilution.

This stripper performed well during the stripping tests. It can be considered for scale-up testing for the following applications if suitable degradation procedures can be established for the solutions:

- o Removing bronze (brazing material) from low-alloy steels, heat and corrosion resistant steels, and stainless steels.
- o Removing cadmium from low-alloy steels, heat and corrosion resistant steels, and stainless steels.

- o Removing nickel from low-alloy steels, heat and corrosion resistant steels, and stainless steels.
- o Removing tungsten carbide from low alloy steels, heat and corrosion resistant steels, and stainless steels.

2. CLEPO Electrostrip B/C

This compound is a noncyanide electrolytic stripper designed to strip nickel, copper, chromium, zinc, and cadmium from steel. The bath can be maintained indefinitely with additions of the makeup components and removal of the sludge buildup.

Test solutions were made up according to the manufacturer's instructions and reactions were run at 25°C (77°F). Stripping rates of 1 mil per hour or greater were observed for cadmium, copper, and lead. Unacceptable corrosion rates were, however, observed for every basis metal tested.

Both components have low initial CODs and are also biodegradable.

D. KIESOW INTERNATIONAL CORP

Nickel Stripper ST is an electrolytic stripper formulated to remove copper, brass, nickel, cadmium, and tin coatings from steel. Two applications are suggested by the manufacturer for the removal of nickel. The solutions were made up according to the application of stripping semibright nickel and run at 54°C (130°F). All conditions were maintained within the manufacturer's operational guidelines.

Acceptable stripping rates were observed for indium and lead. All classes of metals tested exhibited some degree of corrosion. Test solutions had low initial COD values and were not subjected to biodegradability testing.

E. MACDERMID INC.

1. Metex Nickel Stripper SCB

This immersion stripper is designed to strip dull, semibright, bright, or duplex nickel electrodeposits or electroless nickel from copper, brass, and steel substrates. Solutions of this stripper were made according to the manufacturer's specifications. Tests were conducted, however, at 54°C (130°F), which is 30 to 50°F lower than the recommended operating temperature. This apparently altered the stripping characteristics significantly. Under these conditions, nickel was not stripped at all while copper and the copper containing bronze coupons were affected. The steel basis metals were all unaffected under these conditions. Low initial COD values were observed for the test solutions and further biodegradability tests were not conducted.

2. Metex Silver Stripper CB

This immersion stripper was developed to strip silver from copper, brass, and other copper alloys. The solution is an acid based formulation available in full strength, with no preparation or mixing needed.

Reactions were run at 54°C (130°F) with the solution as received. Silver is stripped at an appreciable rate; however, all of the basis materials tested were corroded. The solution is hygroscopic which could account for the observed degradation of the basis metals, but care was taken to assure minimal exposure of the solution to the atmosphere. Solutions of this stripper had low initial COD values, meeting the biodegradability criteria.

F. METALLINE CHEMICALS CORP.

1. Nickel Stripper 6400

Nickel Stripper 6400 is a single-component immersion stripper used to strip nickel from steel, zinc diecast, and copper based parts.

Solutions were made up according to the manufacturer's instructions and tested at 54°C (130°F). A limited amount of the material was made available for testing.

Nickel is stripped at roughly 1/2 mil per hour, and bronze is also affected. The effect on the steel basis materials was negligible. The material is not biodegradable at the 1:600 dilution. The average COD is about 270 ppm. This product may be suitable for scaled-up testing if suitable disposal processes can be identified for the waste solutions.

2. Stripper 672

This immersion stripper is designed to strip tin, tin-lead, and zinc coatings from ferrous and copper substrates. Solutions were prepared following the manufacturer's instructions and reactions were run at 54°C (130°F). The recommended operating temperature is 82 to 93°C (180 to 200°F).

Tin and lead materials were stripped at an appreciable rate, even at the reduced working temperature. Basis metal attack was significant on the copper and bronze coupons, but minimal on the iron base metals and alloys. The solution at 1:600 dilution is not biodegradable. The initial COD, however, is low and around the 150 ppm limit for discharge.

3. Zinc Stripper ST-W

This is an immersion stripper formulated to remove zinc coatings from steel, copper, and brass substrates. Solutions were prepared following the manufacturer's instructions. The temperature at which the reactions were run was 54°C (130°F), which is far below the 93°C (200°F) temperature suggested.

Under the conditions used, none of the metals exhibited a significant susceptibility to stripping, with steel coupons being affected the least. The solutions had low initial COD values, meeting the biodegradability criteria.

G. OMI INTERNATIONAL CORPORATION

1. Oxystrip 6000

Oxystrip 6000 is an electrolytic noncyanide formulation designed to strip duplex nickel and ferronickel deposits from ferrous substrate. Test solutions were prepared according to the manufacturer's instructions. The operating conditions were as described in the Technical Bulletin supplied. The temperature was 38°C (100°F), and 6 volts were applied to the coupons.

Bronze, tungsten carbide, nickel, and chromium plate materials were stripped at greater than 1 mil per hour. Appreciable corrosion of all base materials was observed under the laboratory conditions used. The solution was not biodegradable at the 1:600 dilution.

2. Udylite Immersion Stripper 406

This compound is designed to strip sulfur-free and sulfur-containing nickel deposits from copper and copper alloy substrates. Test solutions were prepared according to the manufacturer's instructions, but the reactions were run at substantially lower temperatures. A range of 66 to 93°C (150 to 200°F) is recommended with 71°C (160°F) optimum. The reactions were run at 54°C (130°F) with apparent differences observed between the experimental results and the manufacturer's claims.

Cadmium and nickel were both stripped at just below 1 mil per hour with no significantly high stripping rate observed for any other plate metals. Low alloy steels and stainless steels were significantly corroded under the conditions employed when exposed to the solutions for extended periods of time (greater than 6 hours). Additionally, copper and bronze were also attacked, although to different extents. Slight oxidation of the copper occurred near the top of the coupon which resulted in a mass loss of just over 0.01 gram for a 28-hour period. The mass loss observed is due to physical removal of the oxidized, discolored area. Appreciable

stripping occurred with the bronze, making that particular application improbable. If higher temperatures could be tolerated at the ALCs, further tests should be conducted with this stripper.

The two components were tested in the 6-hour biodegradation reactions. Repeat analyses indicate that Component 406 is well below the 150 ppm COD limit at the 1:600 dilution from full strength and Component 408 is roughly equal to 150 ppm under the same conditions.

3. Udylite Immersion Stripper 460

This process is designed to strip electrodeposited and electroless nickel coatings from steel and steel alloys. Solutions were prepared following the manufacturer's instructions. The reactions were run at 54°C (130°F), which is 50F° lower than the reported optimum.

Cadmium was the only plate material stripped at a satisfactory rate. None of the basis metals tested were appreciably affected.

Test results indicate that Component 460 is not biodegradable and that a 1:600 dilution of the full strength solution is not low enough to meet NPDES limits. If temperatures higher than 130°F could be tolerated at the ALC facilities, this stripper should be tested further.

4. Udystrip 7000

This electrolytic stripper is designed to strip heavy copper deposits without etch or hydrogen embrittlement from most ferrous substrates. Operating life of this bath is indefinite due to the ability to remove sludge products and rejuvenate the bath with makeup component additions.

Test solutions were prepared according to the manufacturer's instructions. The test conditions maintained during the coupon tests were all within specified conditions. Reactions were run at 32°C (90°F) for periods up to 24 hours.

Copper coupons were stripped at about 12 percent the rate claimed by the manufacturer. Although the stripping rate is low, it is not necessarily unacceptable. Cadmium and tungsten carbide were stripped at an impressive 7 mils per hour and are competitive with other processes designed specifically for those applications.

The test results indicate that no appreciable amount of degradation occurs to steel and steel alloy basis materials. The stripper performed well for cadmium and tungsten carbide coatings while not seriously affecting several steel basis materials. If electrolytic strippers are acceptable in the ALCs, Udystrip 7000 should be considered for scaled-up testing.

The biodegradability results indicate that a 1:600 dilution from full strength is sufficient to meet NPDES discharge limits.

5. XPS-306

This experimental immersion part stripper is currently undergoing testing by the manufacturer and at the INEL. It was formulated as a cyanide-free, amine-free, phosphate-free system to strip electroplated, sulfur-free and sulfur-containing nickel deposits from steel substrates.

Test solutions were made up according to the manufacturer's instructions and run at 54°C (130°F), which is at the lower end of the recommended temperature range. The experimental stripping rate for sulfur-free nickel obtained was equal to that claimed by the manufacturer. The value obtained, 1.4 mils per hour, is comparable to values obtained in cyanide stripping solutions for sulfur-containing nickel deposits. Since sulfur-free nickel is more difficult to strip than many other types of nickel deposits, the stripping rate achieved is very acceptable. No other plate metals were stripped at appreciable rates.

Several steels and steel alloys were subjected to the solutions under operating conditions for periods of 24 hours. None of them were affected to any appreciable extent.

The individual components, 306B and 307A, were subjected to the 6-hour biodegradability experiments. Component 306B tested below the 150 ppm COD test limit. Component 307A has a COD roughly equal to the NPDES cutoff value of 150 ppm. Component 307A is an oxidizing agent that is consumed during general operation and should not be present to any significant extent in spent solutions.

Stripper XPS-306 performed acceptably under the stripping criteria examined. It demonstrated suitability in stripping nickel at a significantly greater rate than comparable cyanide solutions while not degrading low alloy steels or heat and corrosion resistant steels. Additionally, spent solutions need only be treated for metals contamination and pH before discarding in local sewer systems. This stripper has high potential for ALC applications.

H. PATCLIN CHEMICAL COMPANY, INC.

1. DIP N. STRIP

This noncyanide formulation is designed to strip nickel, electroless nickel, and copper from steel by immersion. Test solutions were prepared following the manufacturer's instructions but reactions were run at 54°C (130°F), 30F° below the temperature recommended.

No plate metals were stripped at a significant rate compared with other noncyanide immersion formulations. This is probably because of the reduced operating temperature used. In a similar fashion, no significant effect was observed on the steel basis materials; all are reported with dissolution rates below detection limits as determined from 24-hour tests.

The two components, Ni-2 and Dip N, exhibited COD levels slightly above the NPDES limit of 150 ppm in the 6-hour biodegradability tests. Component Ni-2 demonstrated biodegradability near the end of its 6-hour retention. Part Dip N showed no decrease in COD with exposure to the bioculture.

2. Patstrip Ni

Patstrip Ni is a noncyanide immersion stripper developed for stripping nickel from copper and copper-bearing alloys. The solution contains 10 percent sulfuric acid and is unsuitable for stripping coatings from low-alloy steels. Solutions were prepared according to the manufacturer's instructions and run at 25°C (77°F) as representative of the recommended room temperature.

The solution effectively strips nickel as claimed by the manufacturer. Additionally, cadmium and tin are stripped at the rates of 3 and 6 mils per hour, respectively.

Steel basis metals are significantly corroded, as expected. Copper and the copper containing fuming bronze were not affected under the conditions used. This is in accord with the manufacturer's reported applications.

The component Ni-2 was tested in the 6-hour biodegradability experiments. Its behavior has been discussed previously and is characterized as biodegradable.

This stripper stands up to the claims made by the manufacturer and has demonstrated acceptable behavior characteristics under the criteria evaluated in the laboratory experiments. It should be considered for scale-up testing for stripping: (a) nickel from copper and copper alloys, (b) cadmium from copper and copper alloys, and (c) tin from copper and copper alloys.

3. Patstrip Ni-E

This compound is a noncyanide electrolytic stripper for removing nickel and other metals from steel. It is a single-component formulation than can be regenerated indefinitely by sludge removal and additions of fresh Ni-E.

Test solutions were prepared following the manufacturer's instructions. The reactions were run at 38°C (100°F) to simulate the most rigorous allowable conditions. Bronze, copper, and tungsten carbide were stripped in excess of 10 mils per hour while cadmium coupons were stripped at roughly 4 mils per hour. All of the basis materials were significantly degraded during their 24-hour exposure to the solutions. Much of the observed degradation occurred in the region where electrical connections were made. This type of corrosion would not be observed under the conditions used at the ALCs because of the protection afforded by the masking materials. Significant pitting, however, was observed on the steel coupons resulting in unacceptable surfaces.

The components are not biodegradable under the conditions employed, but have COD values below the NPDES limits.

4. Patstrip No. NiX-85

This noncyanide alkaline stripping process was specifically designed to remove nickel plate from steel, copper, and copper alloys by immersion. The stripping rate is temperature-dependent and is reported to range from 0.25 mils per hour to 1.0 mils per hour at elevated temperatures. Test solutions were prepared as per the manufacturer's instructions. Actual coupon testing, however, was conducted at 130°F, 45F° lower than the optimum recommend temperature. This had an appreciable affect on the nickel stripping rate.

Replicate tests indicated that the product performed as claimed and did not significantly affect the basis materials; copper, copper alloys, low alloy steels, or heat and corrosion resistant steels.

Neither of the components, 72Y or 73W, had low initial COD values. Biodegradation did not occur during the biodegradability tests at 1:600 dilution from full strength. Both components have unacceptably high COD values.

This stripper performed as claimed by the manufacturer and should be considered for scale-up testing. The stripping rate for nickel is low, at 0.23 mils per hour, but significant in two respects. First, the nickel coupons were low in sulfur and consequently more difficult to strip than the sulfur-containing electrolytic deposits plated in the ALC processes. Second, the application includes stripping nickel from copper and copper alloys. This is inherently difficult, due to their similar stripping characteristics. Additionally, if temperature constraints are relaxed and allowed to increase, higher stripping rates will result. This product performed well under the performance criteria evaluated in the laboratory studies for stripping

- o Nickel from low alloy steels
- o Nickel from heat and corrosion resistant steels, including stainless steels,
- o Nickel from copper and copper alloys,
- o Nickel from brazed substrates, including brazed steels.

I. WITCO CHEMICAL CORPORATION, ALLIED-KELITE DIVISION

1. ARP 60

This is a multiapplication product. Application Two is a noncyanide immersion stripping process developed to strip nickel and cadmium coatings from copper and brass substrates. Solutions were prepared in accordance with the manufacturer's instructions. The test temperature of 54°C (130°F) was lower than the 60 to 77°C (140 to 170°F) range recommended.

Nickel was not stripped appreciably; however, indium and tin were stripped at rates around 10 mils per hour. Copper coupons representing basis materials exhibited measurable weight losses; however, no evidence of surface pitting was observed. At the temperature investigated, nickel stripping does not occur to an appreciable extent.

Solutions diluted 1:600 were tested in the 6-hour biodegradability tests. The solution was not biodegradable under the conditions employed. COD values were above the NPDES limits at roughly 280 ppm.

2. ARP 66

ARP 66 is a cyanide-free immersion stripper formulated to removed electroless nickel coatings from ferrous based substrates. The solutions are regenerable with sludge removal and replenishable with the makeup components.

Test solutions were made following the manufacturer's instructions. The temperature used was well below the 93°C (200°F) suggested value, at 54°C (130°F). This had a detrimental effect on the nickel stripping rate which ranged from 0.6 to 2.5 mils per hour as reported in the technical bulletin for different electroless nickel coatings at 91°C (195°F). Nickel and cadmium were stripped at 0.5 and 0.8 mils per hour, and no other plate metals were significantly affected.

None of the basis metals were appreciably affected. Low alloy steels, heat- and corrosion-resistant steels, and copper were tested for periods up to 30 hours. No pitting or significant mass loss occurred over the 30-hour exposure time.

The compound's components did not exhibit biodegradation characteristics, for 1:600 dilutions from full strength, in the 6-hour biodegradation tests. Component A has COD values lower than the 150 ppm NPDES limit and is acceptable. Component B has COD values about 430 ppm, which is more than double the acceptable level.

This product performed well under the stripping criteria evaluated. Scale-up testing should be considered for stripping:

- o Nickel from low-alloy steels
- o Nickel from heat- and corrosion-resistant steels, including stainless steels

- o Nickel from copper substrates
- o Cadmium from low-alloy steels
- o Cadmium from heat- and corrosion-resistant steels, including stainless steels,
- o Cadmium from copper substrates
- o Nickel or cadmium from brazed parts made from steels or super alloys.

J. AIR FORCE PROCESS C-101

C-101 is an electrolytic cyanide stripping process used by the Air Force. Test solutions were prepared in accordance with T.O. 42C2-1-7, and baseline information was obtained for several classes of metals. Silver was stripped initially at a rate of 30 mils per hour, which decreased with time to 15 mils per hour as averaged over a 1-hour period. Tungsten carbide exhibited high initial stripping rates, up to 25 mils per hour, which decreased to much less than one mil per hour over 24 hours. Cadmium exhibited similar stripping behavior with high rates over short times and low rates over extended periods. Copper was stripped at a rate of 3 to 9 mils per hour, which decreased with exposure time. Indium did not strip initially but required some activation time, after which a stripping rate of 3 mils per hour was observed. Long exposure again resulted in reduced stripping rates. Bronze was stripped at rates similar to the pure copper coupons. Lead was the only plate material tested that did not have an appreciable stripping rate regardless of exposure time. Nickel was stripped to an insignificant extent.

All of the basis materials tested were appreciably degraded after 24-hour exposures to the cyanide solution under anodic potential. Low alloy steels and heat and corrosion resistant steels were equally affected. Under the criteria established for this investigation, electrolytic cyanide is technically unacceptable.

Biodegradation of the cyanide solutions was not determined because the laboratory procedure volatilizes the cyanide and renders the test

invalid. Additionally, cyanide solutions have not traditionally been dumped into activated sludge systems, but either drummed and stored or chemically degraded.

K. AIR FORCE PROCESS C-106

C-106 is a cyanide immersion stripping process widely used by the Air Force. Solutions were prepared following the instructions given in T.O. 42C2-1-7. Tests were run to gather baseline information governing acceptable stripping rates for plate materials and corrosion rates for basis materials.

Bronze was stripped at the highest rate, in excess of 10 mils per hour. Cadmium followed at 3 to 6 mils per hour. Silver exhibited stripping rates of 1.5 to 3.5 mils per hour, and copper and lead were the only other plate materials stripped at greater than 1 mil per hour. The sulfur-free nickel and indium coupons were stripped at 0.1 mil per hour or less and not at all, respectively. Tungsten-carbide was similarly not appreciably affected.

The basis materials, including low alloy steels and heat and corrosion resistant steels, exhibited little or no tendency to corrode. Any effects observed could be attributed to atmospheric corrosion after removing the test coupons from solution. Technically, this stripper performs extremely well for most applications except low-sulfur nickel.

L. CONCENTRATED NITRIC ACID

Nitric acid was evaluated on basis materials mainly because its solubilization characteristics are well known for several plate metals. It is a noncyanide immersion stripper frequently diluted to 5 percent by concentrated sulfuric acid. The baths are difficult to maintain because water vapor is readily absorbed and changes the solution's solubilizing characteristics. This is a particular concern in humid electroplating facilities. None of the basis materials tested exhibited significant dissolution in the concentrated acid. The conditions in the laboratory

would be suitable for stripping nickel, copper, tin, lead, zinc, cadmium, silver, and indium; however, it is unlikely that the rigorous conditions could be maintained amid the hustle of activity at the ALC plating shops.

Biodegradability has no application for this stripper. Treatment for metals and neutralization are all that is required to expel spent nitric acid solutions.

M. MASKING MATERIAL EVALUATION

The masking materials were relatively unaffected by the strippers to temperatures exceeding 75°C (167°F). This temperature is 20C° higher than the recommended operating conditions. Only sulfuric acid-containing formulations caused detrimental effects. The results are given in Table 8.

N. DATA MANAGEMENT

In support of the noncyanide stripper program, a data management system was developed, which includes information on the current processes in use at the ALCs for stripping metals as well as other processes conducted in the metal plating shops. The system also contains data concerning the companies and products being surveyed under this program. In addition, the data base includes results from the stripper evaluations performed by manufacturers and distributors.

Software was developed to link all of the different types of data. From the menu-driven software, the user is able to access information on Air Force processes as described by the Air Force TOs and data pertaining to individual products including Material Safety Data Sheets (MSDS), technical reports, and test evaluation data. This data system, developed using dBase III+, can be run on IBM and IBM compatible computers.

The information presented in this report has been entered into the data base and is accessible through the software menu. Figure 3 shows the organization of the data base. Flexibility of the software is inherent; it can be expanded to incorporate other types of information.

TABLE 8. RESULTS OF MASKING MATERIAL COMPATIBILITY TESTS WITH NONCYANIDE STRIPPERS

PRODUCT	MATERIAL	SOFT DEG C	MELT DEG C	DIGEST
Cirstrip NCN-Cu	Wax	60	78	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
Nicstrip NCN-SCB	Wax	40	70	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
Electrostrip S.A.	Wax	45	75	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
Nickel-Sol	Wax	65	78	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
Clepo 204	Wax	70	78	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
Clepo Electrostrip B/C	Wax	50	75	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
Nickel Stripper ST	Wax	38	70	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
Metex Nickel Stripper SCB w/NaOH	Wax	75	81	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
Metex Nickel Stripper SCB	Wax	80	85	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
Metex Silver Stripper CB	Wax	50	70	NO
	Organo-Sol	NE	NE	YES
	Polymer	NE	NE	YES
6400 (NI) B/C	Wax	70	77	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
Stripper 672	Wax	70	77	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO

TABLE 8. RESULTS OF MASKING MATERIAL COMPATIBILITY TESTS WITH NONCYANIDE STRIPPERS (Concluded)

PRODUCT	MATERIAL	SOFT DEG C	MELT DEG C	DIGEST
Zinc Stripper ST-W	Wax	55	75	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
Oxystrip 6000	Wax	50	70	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
Udystrip 406	Wax	60	78	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
Udystrip 7000 CB	Wax	50	70	NO
	Organo-Sol	NE	NE	YES
	Polymer	NE	NE	YES
Udystrip XPS-306	Wax	50	70	YES
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
Dip N Strip III	Wax	45	70	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
Patstrip Ni	Wax	--	75	NO
	Organo-Sol	--	NE	NO
	Polymer	--	NE	NO
Patstrip Ni-E	Wax	50	75	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
Patstrip NiX-85 CB	Wax	NE	75	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
ARP-60	Wax	55	75	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO
ARP-66	Wax	80	82	NO
	Organo-Sol	NE	NE	NO
	Polymer	NE	NE	NO

NE — Indicates that No Effect was observed.

NO or YES — Indicates if the stripper chemically attacked the maskant.

--- — Indicates no effect was observed, due to obscured vision.

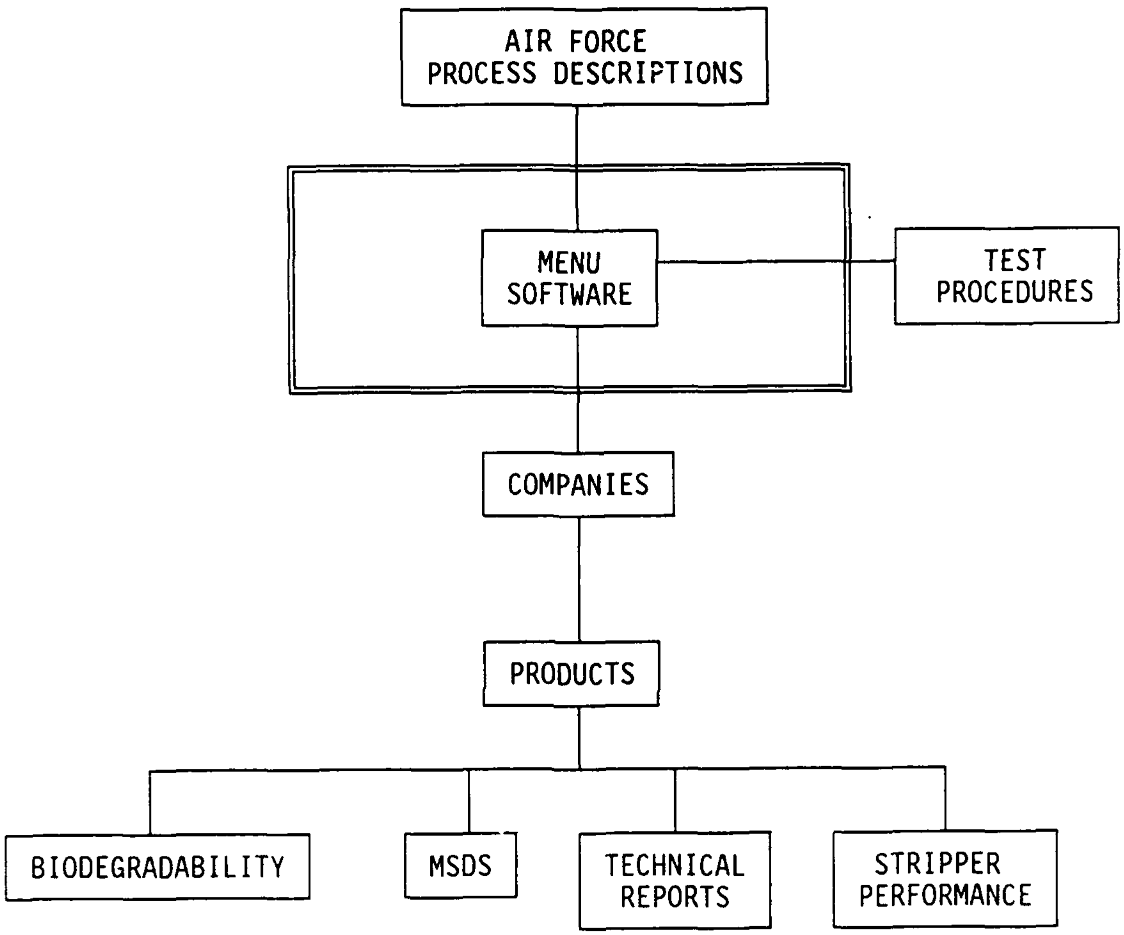

Figure 3. Data Management System.

SECTION V
CONCLUSIONS

The noncyanide metal strippers tested varied widely in their performance characteristics. The performance characteristics most closely evaluated were the stripping rate, biodegradability, and the effect on the basis metals. Four of the commercial strippers evaluated so far have consistently met the acceptable criteria in all three categories. They are:

- Circuit Chemistry Corporations' Cirstrip NCN-CU, which strips copper and bronze from low-alloy steels, stainless steels, and nickel alloys.

- Electrochemicals' Nickel-Sol, which strips nickel and copper from stainless steels.

- OMI International Corporations' Udystrip 7000, which electrolytically removes copper and cadmium from stainless steels.

- Patclin Chemical Company's Patstrip Ni, which strips nickel and cadmium from copper and copper alloys.

Many of the formulations targeted for testing in this program have only a limited test history from the manufacturer to support the applications specified in the Technical Bulletins. Thus, some of the strippers were likely to exhibit poor performance in expanded applications. Applications not specified by the manufacturer were investigated, which inherently biases the data to appear unfavorable; however, in some cases the performance characteristics were quite acceptable in an application not specified by the manufacturer. In all of the applications tested so far, each stripper effectively strips a plate metal consistent with Air Force applications.

For all of the strippers tested, at least one of the basis material coupons was adversely affected by dissolution or pitting. This reflects the wide range of basis materials tested rather than the lack of versatility, which is most obvious.

The three masking materials tested in all of the commercial strippers are compatible within the limits tested. They do not dissolve or degrade to 75°C (167°F) except in sulfuric acid-containing solutions.

The tests conducted in the laboratory assess the biodegradability of the stripper under conditions similar to those of the Tinker AFB IWTP. This actually indicates the potential ability for activated sludge systems to degrade the ingredients, but is not the sole indicator of how well the waste solution can be treated in a full-scale waste treatment process. Two other contributing factors can preclude the stripper components from reaching the activated sludge complex, rendering evaluation of the biodegradation data inappropriate for those cases. Some stripper components having inherently high COD values are decomposed during normal service and never enter the waste treatment system. Mild oxidants behave in this manner. Other components may be precipitated from the waste solution in metal complexes or off-gassed as nonhazardous by-products of the redox reactions upstream from the activated sludge system.

Eight of the noncyanide strippers tested performed acceptably in the laboratory stripping tests. Only four of these solutions met the biodegradability criteria. They are listed on the preceding page.

The remaining four strippers referred to service high-volume Air Force applications and are technically acceptable; however, they did not meet the biodegradability criteria established. These strippers and their applications are:

- o Frederick Gumm's CLEPO 204 for stripping nickel, cadmium, bronze, and tungsten carbide from low alloy steels and stainless steels.

- o Metalline's Nickel Stripper 6400 for stripping nickel from low alloy steels.

- o OMI's XPS-306 for stripping nickel from low alloy steels and stainless steels.

- Witco's ARP-66 for stripping nickel and cadmium from low alloy steels, stainless steels, and copper alloys.

The conclusions are based on the results presented in Figures 4 through 8, where the stripping rates are plotted as a function of stripper formulation, for five individual metals. Results for three plate metals (Nickel 200, Cadmium, Copper) and two basis metals (C4340, 17-4PH) are shown. C4340 and 17-4PH are examples of a low alloy steel, and a corrosion and heat resistant steel, respectively. The test results for two Air Force processes using cyanide are included for comparison. They are labeled CN IM for process C-106, and CN ELEC for process C-101. This information is compiled from Appendices A, C, D, and F.

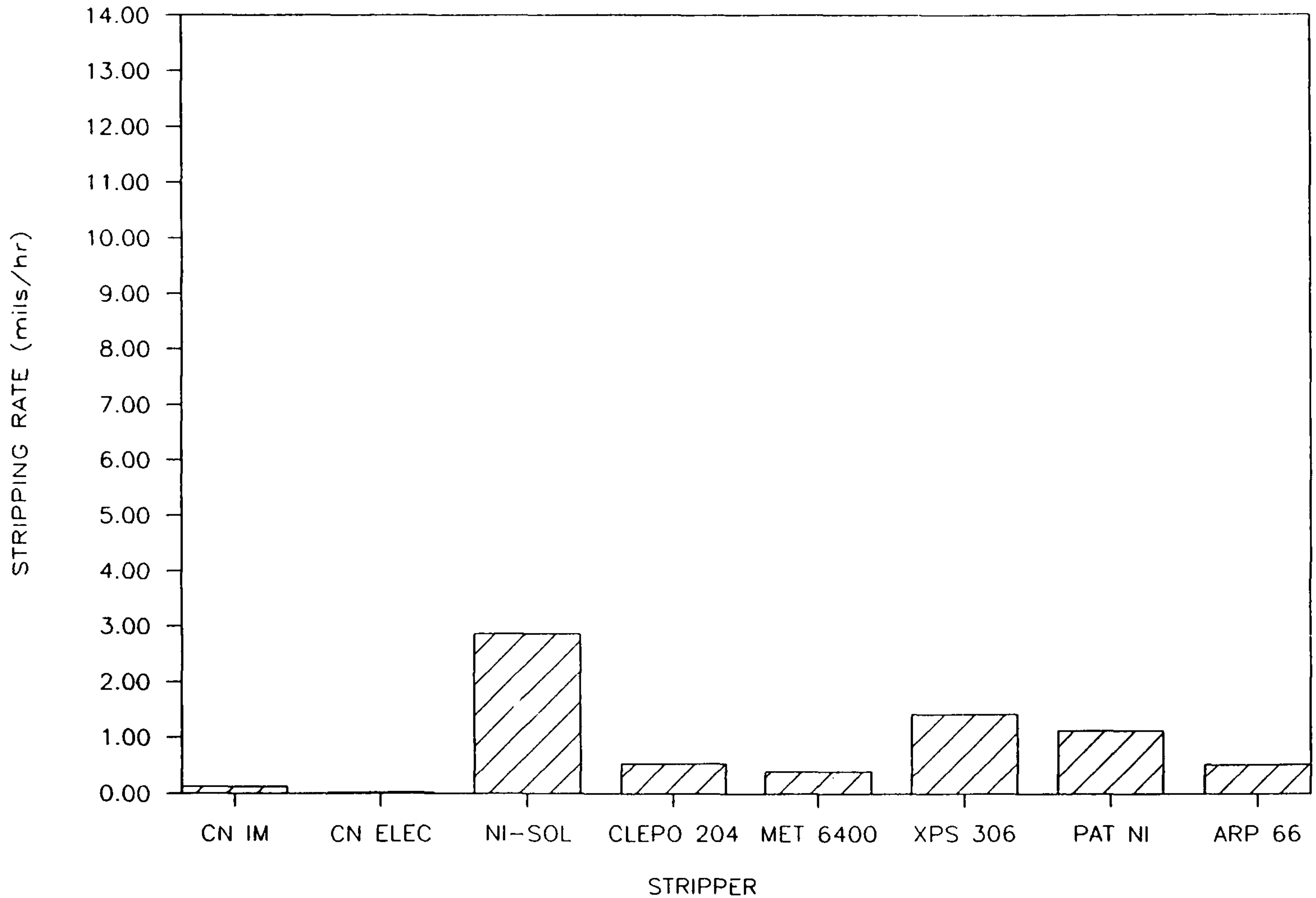

Figure 4. Stripping Rates for Nickel 200.

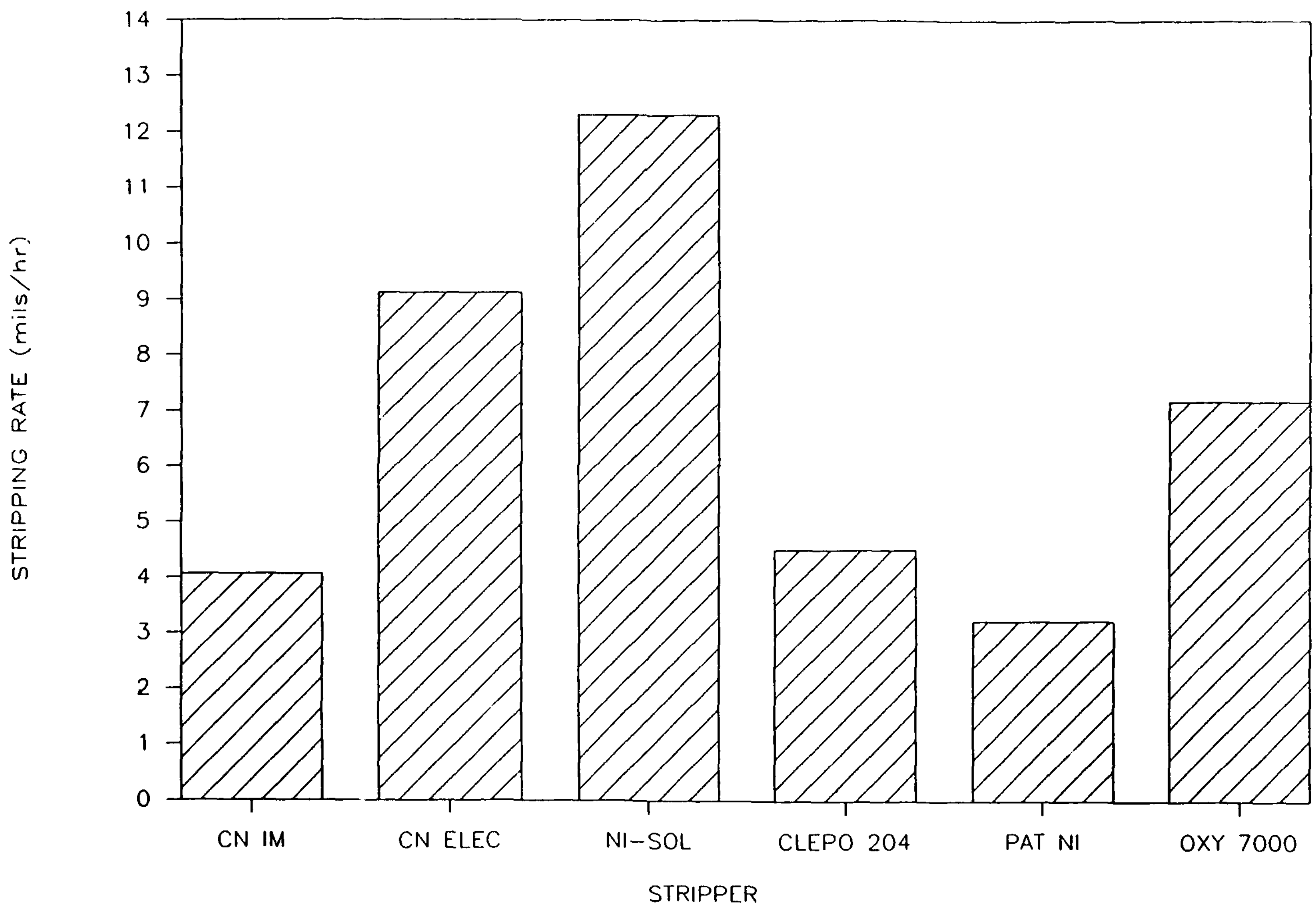

Figure 5. Stripping Rates for Cadmium.

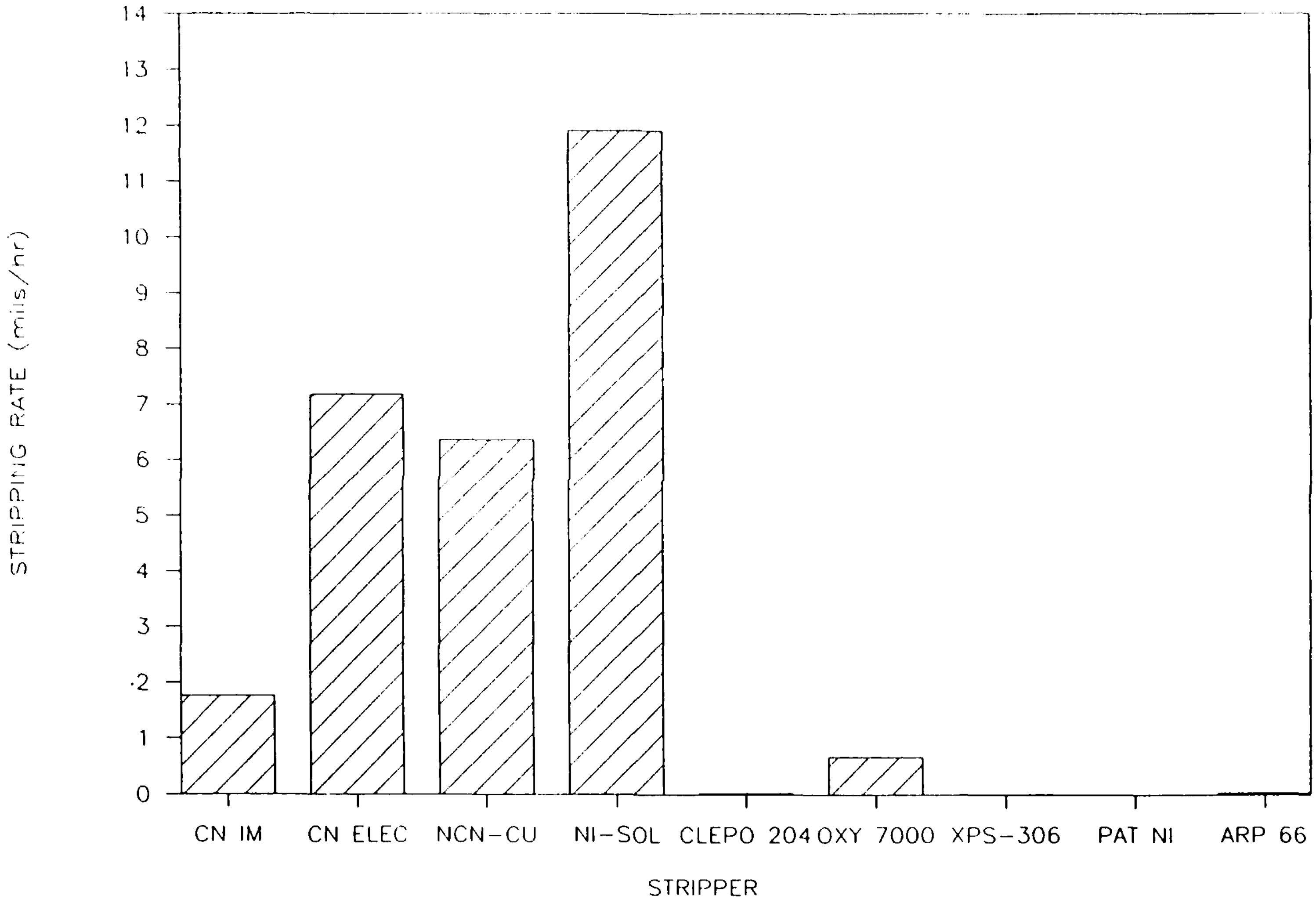

Figure 6. Stripping Rates for Copper 101.

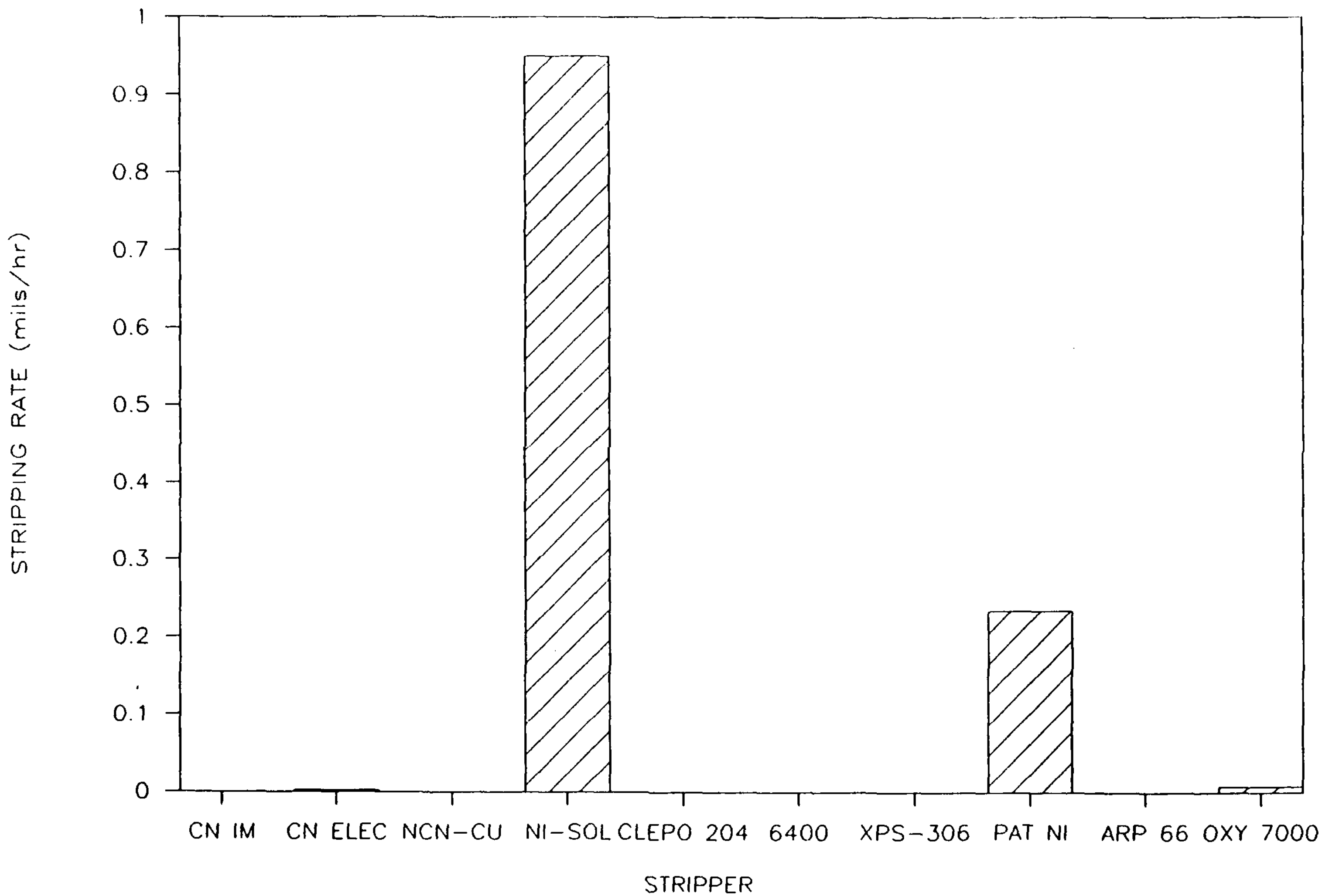

Figure 7. Corrosion Rates on C4340 Steel.

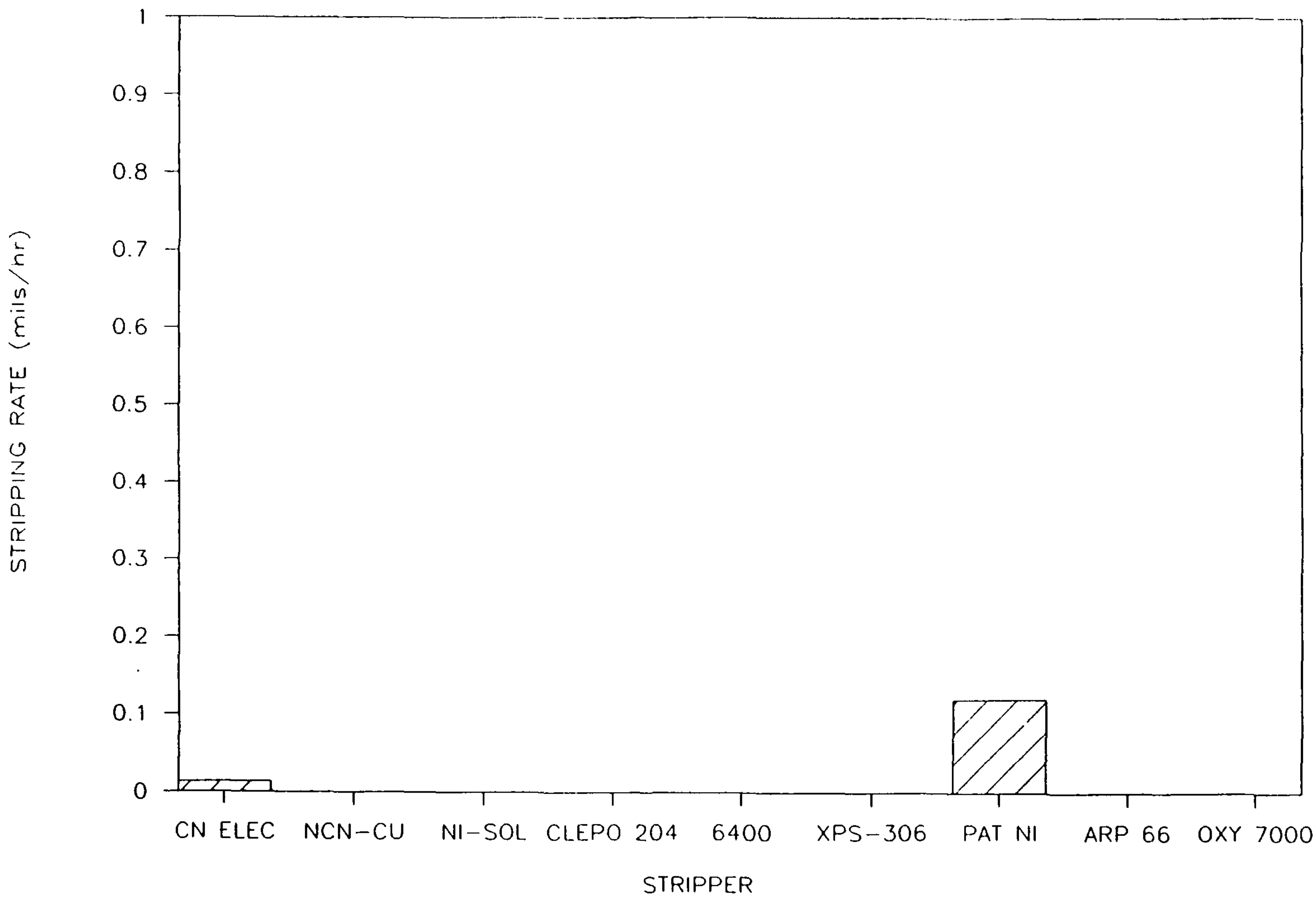

Figure 8. Corrosion Rates on 17-4PH Steel.

SECTION VI
RECOMMENDATIONS

Laboratory stripping studies using coupons and commercial noncyanide metal strippers have indicated that several formulations and processes have high potential for use in Air Force electroplating shops. Noncyanide strippers for removing nickel, copper, cadmium, tin, lead, tungsten carbide, and indium surface coatings from steel and copper alloy basis metals have been identified as being effective for removing surface material without adversely affecting the basis metal. All of these strippers are used commercially and offer a high potential for success in Air Force applications.

Selected strippers should be tested on the pilot-plant scale in field verification tests. This would allow strict supervision of performance characteristics in Air Force applications. The strippers could be evaluated on a broader scale than is possible in the laboratory and performance data can be generated on several coatings within a specific class, i.e., sulfamate nickel and electroless nickel. Testing on this scale would provide the necessary technical information to implement new technologies in the ALCs. Comparative cost analyses and waste disposal information can also be evaluated.

An additional laboratory investigation should be initiated to study and develop noncyanide stripping formulations and procedures. A particular emphasis should be on developing silver strippers and an associated silver recovery process. Through these efforts, new formulations may be developed which could result in large economic savings, and options for silver stripping may become available.

SECTION VII

PHASE II TASKS AND SCHEDULE

A. PHASE II TASKS

Tasks to be completed in Phase II of this program are listed below.

- Task 1. Trailer procurement, installation and setup
- Task 2. Baseline stripper data gathering
- Task 3. Determination/development of test methods for noncyanide strippers
- Task 4. Process methodology enhancement requirements
- Task 5. Evaluation of stripper efficiency
- Task 6. Determination of stripping capacity and stripper regeneration
- Task 7. Rinsing requirements of the noncyanide strippers
- Task 8. Corrosion testing of the noncyanide strippers
- Task 9. Investigation of the mechanistic and chemical nature of stripping processes
- Task 10. Precious metal stripping and recovery
- Task 11. Preliminary cost comparison
- Task 12. Reports.

A test plan has been prepared to include testing of six noncyanide strippers for stripping phosphorus electroless nickel, sulfamate nickel, a nickel-cadmium alloy, and copper from the following basis metals: low alloy or mild steel, heat and corrosion resistant steel, and a high strength steel. The strippers will include both immersion and electrolytic stripper processes. Additionally, stripper mechanism investigation and precious metal recovery tasks are also included. The strippers targeted for testing are:

Cirstrip NCN-CU
Nickel-Sol
Udystrip 7000
Patstrip Ni
XPS-306
CLEPO 204

The CLEPO, XPS, and ARP products were not acceptable under the biodegradation criteria. They are included in the Test Plan because they are noncyanide formulations and perform well under the stripping and basis metal protection criteria. They are also intended for use in high-volume Air Force applications.

1. Task 1. Trailer Procurement, Installation and Setup

Two trailers will be purchased for the Phase II Noncyanide Stripper Program. One trailer will be set up as an analytical support trailer, and the second trailer will be set up for pilot-scale stripping processes.

2. Task 2. Baseline Stripper Data Gathering

Two cyanide strippers, presently used at Kelly AFB, will be tested on a variety of metals. The two strippers are C101, an electrolytic stripper, and C106, an immersion stripper. The plate metals, including phosphorus electroless nickel, sulfamate nickel, a nickel cadmium alloy, and copper will be as bar stock of the specific metal. The basis metal will be coupons that are hung in the stripper bath with the plate metal. The basis metals will include low-alloy or mild steels, heat- and corrosion-resistant and stainless steels, and a high-strength steel. Included in this task will be determining the effects of a new stripper solution and a solution partially loaded with the desired metal, and the efficiency of the stripper following regeneration. This task will provide the data necessary for comparing the efficiency of present cyanide strippers with the efficiency of the proposed noncyanide strippers. Also, during this task, information will be collected from the electroplating shop ι the capacity of the strippers, regeneration requirements, and the quantity of stripper used. This will provide a comparison for the future tests and a basis for the cost comparison. If sufficient information is available, some parts of this task may not be required.

3. Task 3. Determination/Development of Analysis Methods for Noncyanide Strippers

Manufacturers will be contacted to determine the methods available for analyzing the active ingredients of the strippers selected for testing. The analysis is required to determine the activity of the stripper and will be used to monitor the stripper's efficiency and the degradation of the strippers as a function of time. If methods are not available from the manufacturer, a suitable method will be developed and tested. The analytical methods will be incorporated into the stripper testing procedures.

4. Task 4. Process Methodology Enhancement Requirements

In this task, means of improving the solutions' stripping rate will be investigated. This task will be completed on the individual noncyanide strippers before testing in Task 5 (Evaluation of Stripper Efficiency). Methods of improving the stripping rate will include temperature changes, air agitation versus mechanical mixing, and electrochemical methods. In many cases, air agitation is required for oxidation of the metal, a prerequisite to stripping, while in others, mechanical mixing is recommended. Although air agitation supplies mixing, alternative forms of agitation are needed to prevent carryout of volatile components in noncyanide formulations. In many cases, several temperatures are recommended for a stripper. Some of these temperatures depend on the metal being stripped. The investigation of these methods will provide a means of stripping efficiently, and the tradeoff between longer stripping times, higher temperatures, and alternative types of mixing will be considered. The methodology enhancement to be tested in this task include temperature, agitation, and mechanical mixing.

5. Task 5. Evaluation of Stripper Efficiency

Reject airplane parts, as supplied by the ALCs, will be stripped in the noncyanide strippers selected at the optimum conditions as determined in Task 4. The part types used will depend on the parts available. If parts are not available, coupons will be used. The metals most

representative of those presently being stripped at Kelly AFB are phosphorus electroless nickel, sulfamate nickel, a nickel-cadmium alloy or copper plated onto low-alloy or mild steel, heat- and corrosion-resistant steel, stainless steels, and high strength steels. Initial testing will be conducted with fresh stripper solutions. Three parts will be tested simultaneously. During testing, the weight loss and the change in the solution concentration will be monitored as a function of time. The stripper solution will be one-half loaded with the metals representative of those normally stripped in the solution The test matrix will be repeated using this stripper solution. This stripper solution will then be loaded totally with the metals and regenerated according to the manufacturer's instructions. The test matrix will then be repeated using this regenerated stripper solution. Before testing in the stripping solution, the parts will be hand-cleaned using 1,1,1-trichloroethane or P-D-680 (depending on the soil and the part), dried, and weighed. The part and all connections will be coated with masking material. The coated part will be weighed. During testing, the parts will be removed, rinsed, dried, and weighed to determine the metal removed as a function of time. At this time, it is assumed that six noncyanide strippers will be tested.

6. Task 6. Determination of Solvent Stripping Capacity and Stripping Regeneration

The capacity of the strippers for the specific plate metals will be determined. The solutions will be adjusted for temperature, mixing, and agitation as indicated from the tests in Task 4. The cleaned, preweighed coupons will be immersed in the stripper (or stripped) until the stripper is saturated, or no longer capable of stripping. The amount of metal required to do this will be determined through Atomic Absorption Analysis of the solution as a function of time for the specific metals, analysis of the solutions for the active ingredients, and the coupon weight loss. The metal required will be compared to the manufacturers loading rate and the cyanide strippers presently used. Once the stripper has been loaded, the solution will be regenerated according to the manufacturer's instructions. The loading rate will again be determined. This will be repeated for two regenerations of the solution. This will determine the

loading rate as a function of time and the stripper activity as a function of the regeneration. The stripper capacity will be determined for all six of the strippers to be tested in Task 5, and the data used for loading the respective strippers.

7. Task 7. Rinsing Requirements of the Noncyanide Stripper

The active ingredients in the noncyanide strippers will differ significantly from those in the cyanide strippers presently being used for metal stripping. Before plating, the part may require significant rinsing, as required in the part maintenance instructions. The purpose of this task is to determine the degree of rinsing required for further processing of the aircraft part. These data will be correlated with the rinsing requirements for the cyanide strippers. The requirements will be established by determining the noncyanide stripper active ingredient in the rinse water as a function of the number of rinsings and as a function of rinsing time. The data from these tests will be compared, and the required rinsing time and conditions incorporated into Task 5 of this program. Some of the parts used in Task 5 will be tested by rinsing the part removed from the rinse tank in a fresh tank of water and analyzing for the active ingredient.

8. Task 8. Corrosion Testing of the Noncyanide Strippers

The noncyanide strippers selected for testing will be corrosion tested according to the corrosion test presently used by the Air Force. The procedure for these tests have not yet been obtained. It is assumed, as for the solvents for grease/oil removal, procedures exist for immersion and hydrogen embrittlement corrosion testing of the strippers. Corrosion testing for the noncyanide stripper will be performed for those basis metals for which the selected stripper may be applicable in the Air Force operations. If a procedure for corrosion testing the strippers is not available, a procedure will be set up that will incorporate the presence of the stripped metal, galvanic coupling, and will also evaluate the corrosivity of the solution as a function of time (timed interval removal of the coupons). All data from corrosion testing, will be compared to corrosion data from the C-106 and C-101 cyanide strippers.

9. Task 9. Investigation of the Mechanistic and Chemical Nature of Stripping Processes

The purpose of this task is to investigate the mechanism and chemical nature of noncyanide metal strippers. The fundamental information gathered in this task will be used to formulate generic noncyanide strippers for stripping nickel and nickel-cadmium from low alloy and brazed steels, and for stripping copper from low alloy steels. Phase I results show that cyanide stripping solutions can be replaced with noncyanide solutions, but a single formulation will not serve for all of the Air Force's applications. The results show that only two or three plate metals can be effectively stripped by any one of the products tested. Also, the products can only service a limited amount of plate metal/basis metal combinations. This is acceptable from a performance point of view since no additional stripping lines need to be added to existing facilities, although additional separated storage is needed for the different chemicals. For many of the commercial products tested, stripping rates for the indicated applications were not acceptable. This was mainly because the conditions required to strip effectively were not compatible with safety requirements. To meet the service needs of the Air Force, suitable generic noncyanide strippers need to be developed.

Following the test methodology outlined in this task will lead to a fundamental understanding of the required composition of new noncyanide stripping solutions. Electroanalytical methods of analysis will be used exclusively in this part of the study. These techniques are the best available for studying the chemistry of plating and stripping solutions.

10. Task 10. Precious Metal Stripping and Recovery

The purpose of this task is to find commercial noncyanide strippers for precious metal (gold and silver) stripping and conduct bench scale studies for the recovery of these metals from noncyanide strippers.

A literature review and a vendor search will be conducted for noncyanide strippers of precious metals that are available from commercial

sources or reported in the technical journals. These strippers will be tested for stripping rates (dissolution of plating metals), biodegradability, and their effect on the basis metals surfaces. Corrosion studies will be conducted on the basis metals that are plated with precious metals. These data will be gathered in the tests conducted in Task 9.

Upon completion of these studies, bench-scale studies will be conducted to develop techniques to recover precious metals form selected noncyanide strippers. Recovery efficiencies of these techniques will be determined and compared to recovery efficiencies of current techniques used for cyanide strippers.

An electrochemical investigation of the dissolution behavior of gold and silver will be conducted. Cyclic voltamograms and potentiodynamic anodic polarization curves will be run for gold and silver electrodes in aqueous solutions containing noncyanide solvating agents, mild oxidants, and corrosion inhibitors. These tests will be conducted in a fashion similar to those in Task 9. The stripping and plating characteristics can be evaluated simultaneously. This will lead to stripping solutions from which the precious metals can be recovered using existing technologies. Alternative, yet economical technologies for precious metal recovery will be developed on the laboratory scale concurrently.

11. Task 11. Preliminary Cost Comparison

A cost evaluation will be performed on the processes tested and found technically acceptable in the field test verification studies. The cost comparison will include stripper cost, stripper capacity, regeneration costs, and rinsing requirements. These costs will also be compared to the cyanide strippers presently used in the process. Preliminary cost estimates will also be evaluated for the precious metal stripping and recovery processes examined in Phase II of this program.

12. Task 12. Reports

A final report will be written on Phase II of this program. Included in the report will be the procedures for operation/testing, results of all testing, conclusions, cost comparison, and recommendations and test plan for Phase III. In addition, monthly reports of the procedures and results will be provided, as well as an interim Quick-Look Report.

B. PHASE II SCHEDULE

A schedule for tasks to be completed in Phase II of this program is presented on the following page.

TASK OCT NOV DEC JAN FEB MAR APR MAY JUN JULY AUG SEP OCT NOV

TRAILER PROCUREMENT, INSTALLATION AND SET UP
TASK 1

BASELINE STRIPPER DATA
TASK 2

ANALYSIS TEST METHODS
TASK 3

METHODOLOGY ENHANCEMENT
TASK 4

STRIPPER EFFICIENCY
TASK 5

STRIPPING CAPACITY AND REGENERATION
TASK 6

RINSING REQUIREMENTS
TASK 7

CORROSION TESTING
TASK 8

MECHANISTIC NATURE
TASK 9

PRECIOUS METAL RECOVERY
TASK 10

PRELIMINARY COST COMPARISON
TASK
11

REPORTS
TASK
12

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2. Higgins, T. E. and Slater, V. E., Treatment of Electroplating Wastewaters by Alkaline Ferrous Reduction of Chromium and Sulfide Precipitation, ESL-TR-83-21, Engineering and Services laboratory, Air Force Engineering and Services Center, Tyndall AFB, Florida, June 1983.

3. Herlacker, M. F., "Automated Pretreatment of Electroplating Waste at Tinker AFB, OK," Proceedings of the 5th National Conference on Hazardous Wastes and Hazardous Materials, Las Vegas, Nevada, pp. 109-113.

4. 1987 Annual Book of ASTM Standards Section 11, Water and Environmental Technology, Vol. 11.01, p. 192, Method B, Section 22, Coupon Preparation.

5. Total Immersion Corrosion Test for Aircraft Maintenance Chemicals, ANSI/ASTM F 483-77.

6. "Laboratory Corrosion Tests and Standards," ASTM Special Technical Publication 866, Proceedings of the Symposium by ASTM Committee G-1 on Corrosion of Metals, Bal Harbour, FL, November 1983, "Examination and Evaluation of Pitting Corrosion, p. 552.

APPENDIX A

DATA BASE PRINTOUT

This information is printed as submitted from manufacturers, with no attempt to edit or reorganize.

CIRSTRIP NCN-CU

A Recyclable Copper Stripper from Steel Substrates

INTRODUCTION:

NCN-CU is a two component liquid stripper designed to strip copper from steel substrates. NCN-CU is a cyanide-free, chromium-free alkaline stripper which when used as directed will not attack the steel substrate. NCN-CU is used extensively in removing copper plate in various operations including copper plate used as a stop off in heat treat operations. NCN-CU is a recyclable product, which allows for easy disposal for spent stripper and reduces the liabilities associated with typical disposal methods of spent stripper. For more representative:

MAKE-UP:

1. Fill operating tank 1/3 full of water.

2. Add with mild stirring 40% by volume of NCN-CU Part A

3. Add with mild stirring 10% by volume of NCN-CU Part B.

4. Bring solution to working level with water.

4. Heat to the desired operating temperature.

CONSTRUCTION MATERIALS:

Heaters, tanks, and mixers may be constructed of any of the following materials. Care should be taken not to exceed the operating temperatures of manufacturers of such materials.

CPVC, PVC, or Stainless Steel

OPERATING PARAMETERS:

pH...............................9.3 minimum
Temperature.................control room temperature to 105 F.
at 0-6 oz/gal of copper
Agitation..........................recommended
Ventilation...........required, Component A is ammonia based
Time................as required for total removal of copper plate

ANALYSIS & CONTROL: Iodometric methods cannot be used in control of NCN-CU in that component B will interfere with the results.

HANDLING & SAFETY: Always wear goggles and protective clothing when mixing and handling Cirstrip NCN-CU components. Cirstrip NCN-CU components are an alkaline material (liquid) and should be stored in a dry area away from acids. If this material is spilled, flush excess material and dispose of properly and flush exposed area with water. Contact a physician in case of an injury.

If Cirstrip NCN-CU components are splashed into the eyes, flush immediately with cold water for about 20 minutes and contact a physician. In the case of splashing on clothing or skin, remove contaminated clothing and flush with cold water for about 20 minutes. Contact a physician if injury occurs. In the case of Cirstrip NCN-CU components taken internally, contact a physician immediately.

TROUBLE SHOOTING GUIDE

PROBLEM	POSSIBLE CAUSE	SOLUTION
*Pitting of Steel	*Low pH	*Add Part A to raise pH to 9.3 or higher
	*Excessive Chlorides	*Dump bath. Start with fresh mixture *Limit replenishment of used baths to add Part A only. *Do not over add Part B on initial make-up.
*Corrosion of Steel after stripping	*Low pH or excessive Chlorides	*See above
	*Acidic rinse waters	*Add sodium phosphate or add alkaline cleaner to stagnant rinse to raise pH 8-9 *Use hot final rinse to aid in drying
*Low Strip Rate	*Low pH	*Add Part A to rinse pH
	*Low Part B	*Add Part B just before stripping. Once copper accumulates in the stripper, it will aid in stripping.
	High Copper	*Stripping will stop when copper exceeds 12 oz/gal. Part A

*Rapid pH Drop	*Overventing *Overheating	*Cover when not in use. *Do not leave heat on when idle.

SAFETY
PRECAUTIONS:

1. Consult Material Safety Data Sheet.

2. Do not mix Part B or mixed stripper with acids.

3. Ventilate the work area to keep ammonia odors within comfortable limits.

4. Avoid contact with stripper on skin.

?IP NCN-CU PART A

SECTIC?N I - IDENTIFICATI?

Manufacturer's Name:	?ircuit Chemistry Corporation
Phone Number:	(612) 479-2008
Emergency Phone Number:	(612) 479-2008
Effective Date:	12-28-87
Revised Dat?	
Trade Name	Cirstrip NCN-CU Part A
Chemical Fa?y	Alkali
Chemical Formula	Mixture

SECTION II - HAZARDOUS INGREDIENTS

Hazardous Components	Hazardous %	TLV (Units)	Cas No.
Anhydrous Ammonia	15%	25 ppm	(7664-41-7)

SECTION III - PHYSICAL DATA

Boiling Point (F)	172-174
Freezing Point (F)	ND
Volatility/Vol (%)	80
Melting Point	NA
Vapor Pressure (mm Hg)	95.1
Vapor Density (Air=1)	0.60
Solubility in H20	Complete
Appearance/Odor	Clear, Colorless to Light Blue with an ammoniacal odor.
Specific Gravity (H20=1)	1.000
Evaporation Rate	Less than 1
Acidity	Alkaline

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point	Not Flammable
Lower Flame Limit	16.0 for ammonia vapor
Higher Flame Limit	25.0 for ammonia vapor
Extinguish Media	Water Spray, Carbon Dioxide, or dry chemical.
For Fire	Wear Full Protective Clothing.
Unusual Fire Hazard	Solution presents no unusual fire hazard, heavy ammonia fumes can present moderate fire hazards when near a flame.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value	Not established See Section 2.
Over Exposure Effects	Irritation of eyes, conjuctivitis, swelling of eyelids. Irritation of the nose and throat. Coughing, dizziness & vomiting. Irritation to skin.
First Aid Procedures	First Aid: If inhaled, remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Get medical attention. In Case of Contact: immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse.

SECTION VI - REACTIVITY DATA

Chemical Stability	Stable
Conditions to avoid	Inhaling Vapor, contact with eyes
Incompatible Materials	Acids
Decomposition Products	Ammonia fumes
Hazardous Polymerization	Will not occur
Polymerization Avoid	NA

SECTION VII - SPILL OR LEAK PROCEDURE

For Spill	Flush with water to chemical drain.
Waste Disposal Method	Neutralization, precipitation of copper. Dispose of according to Federal, State and local laws.

SECTION VIII - SPECIAL PROTECTION

Respiratory Protection	Canister Type for ammonia, gas mask.
Ventilation	Mechanical blower draft
Protective Gloves	Neoprene
Eye Protection	Sealed goggles
Other Protective Equipment	Neoprene apron and boots
Handling and storage	Store away from heat & out of sunlight.

SECTION IX - SPECIAL PRECAUTIONS

Hazard Class	Corrosive Material
DOT Shipping Name	Alkaline Corrosive Liquid N.O.S
Reportable Quantity (RQ)	NA
UN Number	NA
NA #	1719
Packaging Size	5, 15, 55 gallon

CIRSTRIP NCN-CU PART B

SECTION I - IDENTIFICATION

Manufacturer's Name	Circuit Chemistry Corporation
Phone Number	(612) 479-2008
Emergency Phone Number	(612) 479-2008
Effective Date	12/29/87
Revised Date	
Trade Name	Cirstrip NCN-CU Part B
Chemical Family	Alkaline Oxidant
Chemical Formula	Mixture

SECTION II - HAZARDOUS INGREDIENTS

Hazardous Components	Hazardous %	TLV (Units)	Cas. No.
Sodium Chlorite	20%	Not Establ.	7758-19-2

SECTION III - PHYSICAL DATA

Boiling Point (F)	182-186
Freezing Point (F)	ND
Volatility/Vol (%)	75
Melting Point	NA
Vapor Pressure (mm Hg)	110.5
Vapor Density (Air=1)	0.620
Solubility in H2O	Complete
Appearance/Odor	Clear, Colorless with a slight Chlorine odor.
Specific Gravity (H2O=1)	1.15
Evaporation Rate	Less than 1
Acidity	Alkaline

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point	Non-Flammable
Lower Flame Limit	NA
Higher Flame Limit	NA
Extinguish Media	Same as surrounding area
For Fire	Wear Full Protective Clothing
Unusual Fire Hazard	When heated emits toxic fumes of chlorides, can react with reducing material.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value	Not Established
Over Exposure Effects	Irritation of eyes, conjuctivitis, swelling of eyelids. Irritation of the nose and throat, coughing, dizziness & vomiting. Irritation to skin.
First Aid Procedures	First Aid: If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Get medical attention. In case of contact: immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse.

SECTION VI - REACTIVITY DATA

Chemical Stability	Stable
Conditions to Avoid	Excessive heat
Incompatible Materials	Acids, Reducers, Oxidizers, Organics
Decomposition Products	Chlorine
Hazardous Polymerization	Will not occur
Polymerization Avoid	NA

SECTION VI - SPILL OR LEAK PROCEDURE

For Spill	Flush with water to chemical drain.
Waste Disposal Method	Return to vendor or dispose of according to Federal, State and local regulations

SECTION VIII - SPECIAL PROTECTION

Respiratory Protection	Canister Type, Gas Mask
Ventilation	Mechanical Blower Draft
Protective Gloves	Neoprene
Eye Protection	Sealed goggles

Other Protective Equipment	Neoprene apron and boots
Handling and Storage	Store away from heat and out of sunlight.

SECTION IX - SPECIAL PRECAUTIONS

Hazard Class	Corrosive Material
DOT Shipping Name	Alkaline (Corrosive) Liquid N.O.S
Reportable Quantity (RQ)	NA
UN Number	NA
NA #	1719
Packaging Size	5, 15, 55 gallon

NICSTRIP NCN-SCB

(A Non-Cyanide Nickel Immersion Stripper
From Steel, Copper & Brass)

INTRODUCTION:

NICSTRIP NCN-SCB is an immersion stripper designed to remove nickel coatings from copper, steel or brass or assemblies thereof. NCN-SCN will also remove high phosphorous electroless coatings from the above metals with a simple change in makeup chemistry.

MAKE-UP:

NCN-SCB is supplied as a two (2) component system.
NCN-SCB-1 powder and and NCN-SCB-2 a liquid.

Make-up is as follows:

5.5oz./gal. of NCN-SCB-1 powder
20% by volume of NCN-SCB-2 liquid

Electroless Only - 2 oz/gallon of sodium hydroxide
Operating Temp. 70 - 175 F.

1. Fill tank 3/4 with warm water.
2. Add the NCN-SCB-2 and stir.
3. Add NCN-SCB-1 and stir. The warmer the solution the faster the dissolving.
4. Complete filling the tank to desired volume and heat to desired temperature.

EQUIPMENT:

Tanks may be constructed of steel, stainless steel or polypropylene. Heater can be made of steel, stainless steel, or teflon. Work baskets or racks should consist of the same.

CONTROL:

Prolonged operation of NCN-SCB at extended temperatures will deplete bath life whether in use or non-use. Excessive temperatures beyond 175 F. will deplete bath rapidly. Levels of bath should be maintained by additions of water and NCN-SCB-2 in the proper proportions. If nickel plate is excessively passive, an acid dip of 50% hydrochloric will help activate stripping. Smuts that may appear on work may be removed with a dip of either dilute acid or 5-6 oz. per gallon of cyanide.

HANDLING AND STORAGE:

Normal precautionary measure for handling alkaline materials should be observed. Face masks, rubber gloves and aprons are recommended. In case of skin contact, flush immediately with

water for 15 minutes and contact a physician. If taken internally call a physician immediately. If splashed in eyes flush for 15 minutes and get medical attention.

The information contained herein is based upon our tests and technical experience. Because actual conditions may vary and the conditions of the use of the product is beyond our control, we make no warranty, expressed or implied, except that the product conforms to the above data sheet.

NICSTRIP NCN-SCB 1

SECTION I - IDENTIFICATION

Manufacturer's Name:	Circuit Chemistry Corporation
Phone Number:	(612) 479-2008
Emergency Phone Number:	(612) 479-2008
Effective Date:	
Revised Date:	7/8/87
Trade Name	Nicstrip NCN-SCB 1
Chemical Family	Organic
Chemical Formula	Proprietary

SECTION II - HAZARDOUS INGREDIENTS

Hazardous Components	Hazardous %	TLV (Units)	Cas. No.
Nitrated Organic Acid			

SECTION III - PHYSICAL DATA

Boiling Point (F)	NA
Freezing Point (F)	NA
Volatility/Vol (%)	NA
Melting Point	NA
Vapor Pressure (mm Hg)	NA
Vapor Density (Air=1)	NA
Solubility in H2O	Soluble
Appearance/Odor	Off-White Powder
Specific Gravity (H2O=1)	NA
Evaporation Rate	NA
Acidity	Solution Acidic

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point:	NA
Lower Flame Limit:	NA
Higher Flame Limit:	NA
Extinguish Media:	Water Fog and CO2.
Special Fire Fighting: Procedures:	Usual Protective Equipment including self-contained breathing apparatus to prevent inhalation of fumes.
Unusual Fire Hazard:	Grinding or mixing in the presence of dry alkali (sodium or potassium hydroxide) may cause auto-ignition.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value: Not established.

Overexposure Effects: May cause skin, eye and mucous membrane irritation.

First Aid Procedures: First aid: in case of eye contact, flush immediately with plenty of water for at least 15 minutes and get medical attention; for skin, wash thoroughly with soap and water. First aid: If inhaled, remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

SECTION VI - REACTIVITY DATA

Chemical Stability: Stable

Conditions to Avoid: NA

Incompatible Materials: Grinding or mixing in the presence of dry alkali may cause autoignition.

Decomposition Products: Oxides of nitrogen may occur during fire.

Hazardous Polymerization:

Will not Occur.

Polymerization Avoid: NA

SECTION VII - SPILL OR LEAK PROCEDURE

For Spill: Sweep or vacuum up spilled material, then wash area with water.

Waste Disposal: According to Federal, State and local regulations.

SECTION VIII - SPECIAL PROTECTION

Respiratory Protection: American Optical Respirator #R2090N

Ventilation: Local

Protective Gloves: Rubber

Eye Protection: Safety Goggles

Other Protective Equipment: Coveralls to minimize contact.

Handling and Storage:	Don't store near excessive heat or open flame. Shower thoroughly with soap and water after handling material.

SECTION IX - SPECIAL PRECAUTIONS

Hazard Class:
DOT Shipping Name:
Reportable Quantity (RQ): NOT REGULATED
UN Number:
NA #:
Packaging Size:

NICSTRIP NCN-SCB 2

SECTION I - IDENTIFICATION

Manufacturer's Name:	Circuit Chemistry Corporation
Phone Number:	(612) 479-2008
Emergency Phone Number:	(612) 479-2008
Effective Date:	
Revised Date:	7/8/87
Trade Name:	Nickstrip NCN-SCB 2
Chemical Family:	See Section II
Chemical Formula:	Proprietary

SECTION II - HAZARDOUS INGREDIENTS

Hazardous Components	Hazardous %	TLV (Units)	Cas No.
Ethylene Diamine	P/I	10 ppm	107-15-3
Sodium Diethyldithiocarbamate	P/I	Not listed	

SECTION III - PHYSICAL DATA

Boiling Point (F)	NA
Freezing Point (F)	NA
Volatility/Vol (%)	NA
Melting Point	NA
Vapor Pressure (mm Hg)	NA
Vapor Density (Air=1)	NA
Solubility in H20	Soluble
Appearance/Odor	Liquid
Specific Gravity (H20=1)	1.000
Evaporation Rate	NA
Acidity	ND

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point	NA
Lower Flame Limit	NA
Higher Flame Limit	NA
Extinguishing Limit	NA
Extinguish Media	Water Fog, CO2
Special Fire Fighting Procedures:	Self-contained breathing apparatus is necessary in confined areas.
Unusual Fire Hazard:	Irritating vapors may be given off if exposed to elevated temperatures or open flame.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value	Not established, See Section II.
Over Exposure Effects	May cause moderate to severe eye and skin irritation or burns. Vapor may be irritating if inhaled.
First Aid Procedures	First Aid: In case of eye contact, flush immediately with plenty of water for at least 15 minutes and get medical attention; For Skin: wash thoroughly with soap and water. Ingestion: DO NOT INDUCE VOMITING. Give Large amounts of water and at least one ounce of vinegar in an equal amount of water. Get medical attention. First Aid: If inhaled, remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

SECTION VI - REACTIVITY DATA

Chemical Stability:	Stable
Conditions to Avoid:	Excessive Heat
Incompatible Materials:	Acid, Oxidizing Agents.
Decomposition Products:	CO, CO2, Oxides of nitrogen.
Hazardous Polymerization:	Will not occur
Polymerization Avoid:	NA

SECTION VII - SPILL OR LEAK PROCEDURE

For Spill: Confine area of spills. Cover wet material with sand. Transfer to suitable containers for disposal.

Waste Disposal Method: According to Federal, State & Local regulations.

SECTION VIII - SPECIAL PROTECTION

Respiratory Protection:	Ethylendiamine Respirator cartridge.
Ventilation:	Local and Mechanical Exhaust
Protective Gloves:	Rubber gauntlet
Eye Protection:	Chemical Safety Goggles
Other Protective Equipment:	Rubber apron and boots.
Handling & Storage:	Avoid spills, eye and skin contact. Do not inhale vapors. Wash thoroughly after handling.

SECTION IX - SPECIAL PRECAUTIONS

Hazard Class:	Corrosive Material
DOT Shipping Name:	Corrosive liquid N.O.S.
Reportable Quantity (RQ):	
UN Number:	1760
NA #	
Packaging Size:	

ELECTROSTRIP S.A.

Electrostrip S.A. is an electrolytic stripper designed to strip copper, nickel, chromium, cadmium, tin, and silver from mild steels and titanium.

Electrostrip S.A. has infinite life, it never has to be discarded. Maintenance additions and occasional sludge removal are all that is required to make the bath operable.

Electrostrip S.A. can strip nickel deposits at a rate of 7 mils per hour, other metals are stripped even faster. The parts to be stripped are made anodic. The metals stripped form the oxide at the cathode and falls to the bottom of the tank as a sludge. The sludge can be removed periodically by decanting.

MAKE-UP OF ELECTROSTRIP S.A. SOLUTION

	By Volume	For 100 Gals
Electrostrip S	40%	40 gal
Electrostrip A	1%	1 gal

Fill tank 1/2 full of water, add Electrostrip S then Electrostrip A. Then dilute to final volume with water. Adjust pH with Nitric Acid to between 5.0 - 6.0.

OPERATING CONDITIONS

Temperature	70 - 140 F
Current Density	60 - 250 amps/sq. ft.
Voltage	8 - 15 Volts
Anodes	Titanium anodes, plastisol coated copper racks with titanium hooks. Cross section should be large enough to carry current without overheating.
Cathode to Anode Ratio	1:1 to 2:1
Exhaust	Recommended
Tanks	Reinforced fiberglass or stainless steel. Plastic or rubber lined tanks may be used with the temperature limitations.

MAINTENANCE & CONTROL

pH	5.0 - 6.0. Use nitric acid to lower pH. pH rises with use.
Density	8 - 15 Baume' at 70 F. If Baume' drops below 8 Be' add Electrostrip S. Electrostrip S is usually added only to a new bath. However, it may be needed if drag out is high or if solution is lost during decanting. If Baume' is above 15 Be', decant solution and add fresh water to lower Baume'.
Electrostrip A	Electrostrip A is maintained by analysis. Its function is to increase stripping rate. It should be maintained between 0.8 - 1.2% by volume.

COLORIMETRIC PROCEDURE FOR ANALYSIS OF ELECTROSTRIP A

CONCENTRATION USING ELECTROSTRIP A TEST KIT

1) Pipette a 1 ml sample into a 300 ml graduated cylinder filled with water.

2) Mix thoroughly.

3) Pour approximately 25 ml sample from Step (2) into the marked cup provided.

4) Dissolve the crystals on the tip of the Electrostrip Test Vials in sample from Step (3) and mix.

5) Place the tip into one of the four depressions in the bottom of the cup. Snap the tip by squeezing the ampoule toward the side of the cup. The sample will fill the ampoule. Remove the filled ampoule from the cup. Cover the tip with a finger and invert several times to mix.

6) Compare the color of ampoule with the standards in the comparator. This gives the reading in percent by volume of Electrostrip A.

NOTE: If reading is above range of comparator; use 600 ml dilution in Step (1). Multiply results by 2.

ELECTRO-BRITE ELECTROSTRIP A

PHYSICAL AND CHEMICAL CHARACTERISTIC

Boiling Point: Unknown   Specific Gravity: 0.939

Vapor Pressure: Unknown mm Hg at

Stable: XX Yes   Solubility in Water: limited

Flammable XX Yes   Flash Point: unknown

Extinguisher Media: Carbon Dioxide

Special Fire Fighting Procedures: Cool containers near fire.

Appearance and Odor: Amber to red-brown liquid; aromatic odor.

PHYSICAL HAZARDS

Ingredient	Cas No.	Hazard Type
Methanol	67-56-1	Flammable liquid
Phenol	108-95-2	Combustible liquid

HEALTH HAZARDS

Ingredient	Cas No.	Hazard Type	Exposure Limit
Methanol	67-56-1	Irritant, eye	200 ppm (TWA)
Phenol	108-95-2	Toxic, corrosive	5 ppm (TWA)

Ingredients listed as carcinogens or potential carcinogens

Ingredient Cas No. Listed By: NTP IARC OSHA

-N O N E-

Primary Routes of Entry: Skin contact and inhalation of vapor and mists.

Signs and Symptoms of Exposure: Eye and skin irritant. Breathing vapors can cause irritation of nose and throat. Severe exposure may cause dizziness or unconsciousness. Ingestion of sufficient quantity may be fatal.

EMERGENCY AND FIRST AID PROCEDURES

Eye: Flush with water for 15 minutes and see physician.

Skin: Flush with water and remove contaminated clothing. Contact physician in event of irritation.

Inhalation: Remove person to fresh air. Contact physician in event of irritation of throat or nose.

Ingestion: If patient is conscious, dilute by drinking two glasses of water. DO NOT induce vomiting. Obtain immediate medical attention.

PRECAUTIONS FOR SAFE HANDLING

Respiratory Protection (Type): Cannister type may be required in confined areas.

Ventilation: As necessary to eliminate fumes.

Eye Protection: Goggles or face shield.

Protective Gloves: Rubber or vinyl.

Other Protective Equipment: Rubber apron.

Storage Precautions: Store in cool area away from heat or flames

Hazardous Decomposition Products: None reported.

Incompatibility With Other Materials: Strong oxidizing agents.

Steps To Be Taken In Case Of Spills Or Leaks: Flush with large amounts of water to waste treatment system.

ELECTRO-BRITE ELECTROSTRIP S

PHYSICAL AND CHEMICAL CHARACTERISTICS

Boiling Point: 212 F. Specific Gravity: 1.15

Vapor Pressure: unknown mm Hg at

Stable: xx Yes Solubility in Water 100%

Flammable: xx No Flash Point: NA

Extinguisher Media: NA

Special Fire Fighting Procedures: NA

Appearance and Odor: Colorless, odorless liquid.

PHYSICAL HAZARDS

Ingredient	Cas No.	Hazard Type
-N O N E-		

HEALTH HAZARDS

Ingredient	Cas No.	Hazard Type	Exposure Limit
	-N O N E-		

Ingredients listed as carcinogens or potential carcinogens

Ingredient	Cas No.	Listed By: NTP	IARC	OSHA
	-N O N E-			

Primary Routes of Entry: Skin and eye contact.

Signs and Symptoms of Exposure: None reported.

EMERGENCY AND FIRST AID PROCEDURES

Eye: Flush with water for 15 minutes and contact physician.

Skin: Flush with water and remove contaminated clothing. Contact physician in event of irritation.

Inhalation: Remove person to fresh air. Contact physician in event of irritation of throat or nose.

Ingestion: If patient is conscious, dilute by drinking two glasses of water. DO NOT induce vomiting. Obtain immediate medical attention.

PRECAUTIONS FOR SAFE HANDLING

Respiratory Protection (Type): Not normally required.

Ventilation: No special requirements.

Eye Protection: Splash goggles of face shield.

Protective Gloves: Rubber or vinyl.

Other Protective Equipment: Rubber apron.

Storage Precautions: Store in well ventilated area away from heat.

Hazardous Decomposition Products: Heating to dryness may release toxic fumes of ammonia and nitrogen oxides.

Incompatibility With Other Materials: Metals and organic materials.

Steps To Be Taken In Case Of Spills Or Leaks: Flush with water to waste treatment system.

NICKEL-SOL PROCESS

GENERAL DESCRIPTION

The Electrochemicals NICKEL-SOL Process is a hydrogen peroxide-sulfuric acid formulation designed to strip nickel and copper from aluminum, plastic and stainless steel.

The Electrochemicals NICKEL-SOL Process can replace nitric acid stripper which cause the evolution of harmful NOX fumes.

The processing solution does not deteriorate to the point where it must be dumped. The copper and nickel dissolved can be recovered in the form of copper sulfate and nickel sulfate respectively.

The Electrochemicals NICKEL-SOL Process does not contain cyanide or chelating agents and treatment of the subsequent rinse water is reduced to simple neutralization and precipitation.

The Electrochemicals NICKEL-SOL Process offers the following advantages:

1. Does not attack plastisol coatings.

2. The bath can be regenerated indefinitely, eliminating frequent dumping and the related waste treatment cost.

3. The economical recovery of the dissolved nickel and copper is made possible by crystallization.

4. The system, in most cases, is readily adaptable to most existing automatic, semi-automatic and manual operations.

5. Economy.

6. Simple control and maintenance.

ELECTROCHEMICALS NICKEL-SOL PROCESS

The Elctrochemicals NICKEL-SOL Process may be used in almost any industrial application where the removal of nickel and copper from base surfaces of aluminum, plastic and stainless steel is required. The bath composition can be adjusted to meet the specific operating requirements.

Some of the typical operations include:

A. Stripping electroless nickel from process tanks.

B. Stripping nickel and copper from stainless steel rack tips.

C. Stripping electroless copper from process tanks.

D. Stripping of nickel and copper from aluminum substrates.

BATH MAKE-UP

A typical bath make-up for the NICKEL-SOL Process is as follows:

	Optimum	Range
Sulfuric Acid	10% by volume	8-12% by volume
NICKEL-SOL I	12% by volume	10-15% by volume
Electro-Brite CPX-II	1.0 lb/100 gal.	1.0-2.0 lb/100 gal
Copper Metal	0.5 oz/gal	
Equivalent Copper Sulfate ($CuSO_4.5H_2O$)	2.0 oz/gal	

The following make-up procedure is recommended:

1. Add water to make up the tank to 50% of final working volume.

2. Stainless steel (300 Series) equipment or when stripping off stainless steel base (see equipment) requires the addition of a minimum of 2 oz/gallon of copper sulfate ($CuSO_4.5H_2O$). Dissolve completely.

3. While mixing, SLOWLY add the required amount of 66 Baume' Sulfuric Acid. Do not let solution temperature exceed 140 F.

4. Dissolve CPX-II in a small amount of water and add to the tank.

   CAUTION...At this point the bath temperature must be below 130 F before making any further additions.

5. Add required amount of NICKEL-SOL.

6. If necessary, add water to make-up the balance of the bath.

The exact bath composition may vary depending upon particular application. Our technical department is available for specific recommendations.

TYPICAL CYCLE

A typical cycle consists of:

1. Chrome removal (if necessary)
2. Water rinse
3. Electrochemical NICKEL-SOL Process
4. Water rinse
5. Dry or Preprocess

OPERATION, CONTROL AND MAINTENANCE

Temperature	Room to 130 F.
Time (dwell)	As required
Agitation	Recommended (Air or mechanical)
Stripping Rate Nickel	6-7 mil/hr. (optimum, concentration 120 F)
Stripping Rate Copper	9-10 mil/hour (optimum, concentration 120 F)

The Electrochemicals NICKEL-SOL Process is composed of a dilute solution of sulfuric acid, a stripping agent and small quantities of proprietary stabilizing additives.

The primary stripping agent is NICKEL-SOL I. NICKEL-SOL I is a highly stabilized grade of hydrogen peroxide designed and specifically stabilized for use in Electrochemicals NICKEL-SOL Process. The usual concentration of NICKEL-SOL I in the bath is 10-15% by volume. the exact concentration will be controlled by the speed of operation desired. Higher levels can result in faster stripping rates, all other conditions remaining the same. To minimize drag-out losses and provide the most economical operation, it is recommended that NICKEL-SOL I be used at the lowest concentration that will produce the desired result. NICKEL-SOL I should be controlled by analysis.

The consumption of NICKEL-SOL I is directly related to the amount of copper or nickel removed during the stripping cycle and can be calculated with reasonable accuracy. For every pound of nickel metal stripped, 4.0 lb. of NICKEL-SOL I** is consumed. One pound of copper metal stripped consume 1.68 pound of NICKEL-SOL I. Per square foot of .001 inch thick deposit NICKEL-SOL consumption if as follows:

Nickel: (.046 lb Nickel metal per mil sq. ft.)
.184 lb. NICKEL-SOL I consumed.

Copper: (.046 lb. Copper metal per mil sq. ft.)
.077 lb. NICKEL-SOL I consumed.

**NICKEL-SOL I weighs 10 pound/gallon

Dwell or cycle time in the Electrochemicals NICKEL-SOL solution is related to deposit thickness. Average time to strip 7 mils of nickel is 1 hour, but the solution can be adjusted for longer or shorter times. Normally, the less time available, the higher the NICKEL-SOL I concentration.

Electro-Brite CPX-II is a stabilizing compound which provides a reserve against stabilizer drag-out losses and permits operation of the solution at higher temperatures. The initial bath make up requires 1.0 lb/100 gallon of solution. Because Electro-Brite CPX-II is consumed, a daily addition of 0.5 lbs/100 gallon per

day is required to insure good bath stability. The operation of the NICKEL-SOL solution is slightly exothermic. The heat generated is normally very small and in most installations, is dissipated to the atmosphere. However, air agitation of the bath will help disperse this heat and is recommended to shorten immersion time, reduce NICKEL-SOL I consumption, and maintain bath uniformity.

In installations where there is a high volume work load per gallons of Electrochemicals NICKEL-SOL solution, it may be necessary to provide some cooling. Therefore, it is recommended that a coil for heating and cooling be provided with a suitable temperature control, to allow control of temperature +5 F.

Nickel and copper sulfate accumulates in the bath during operation.

The performance of the bath is constant even when saturated. However, the nickel and copper sulfate will begin to crystallize when saturation is reached. Additionally crystallization will also take place when temperature of the bath is reduced, since the ability to keep the nickel and copper sulfate in solution is temperature related. The lower temperatures have lower saturation levels. Therefore, the operating temperature and temperature control are both extremely important to the successful operation of the Electrochemicals NICKEL-SOL Process. The greater the differential between operating and room temperature the easier nickel sulfate and copper sulfate can be removed by crystallization. Room temperature operations cannot be regenerated.

Referring to the attached curve #1, it can be seen that the saturation point for nickel sulfate ($NiSO_4 \cdot 6H_2O$) at 130 F is 90 oz/gal; at 80 F it is 52 oz/gal. By lowering the temperature of the stripping solution, containing 90 oz/gal at 130 F, to 80 F, we can theoretically remove 38 oz/gal of nickel sulfate crystals. This crystallizing action does not take place at 100% efficiency but it is sufficient enough to continuously remove nickel from the stripping solution, as nickel sulfate, and permit indefinite operation of the bath without dumping. Copper sulfate can also be crystallized in the same manner, see attached curve #2 for saturation curve.

Copper and nickel are removed from the Electrochemical NICKEL-SOL solution as copper sulfate pentahydrate ($CuSO_4 \cdot 5H_2O$) and nickel sulfate ($NiSO_4 \cdot 6H_2O$). At any given operating temperature there is a corresponding maximum copper and nickel concentration that the solution can hold, without the formation of copper and nickel sulfate crystals. While this concentration does not interfere with the stripping rate, it can cause problems when it crystallizes in pumps, recirculating pipes, etc.

The nickel and copper can be controlled rather closely. When the Electrochemicals NICKEL-SOL bath approaches the saturation value for nickel and copper sulfate at any given operating temperature,

the solution is transferred to another tank and allowed to cool to room temperature. Under these conditions, the excess copper or nickel will crystallize out as copper or nickel sulfate. Separating the Electrochemicals NICKEL-SOL solution, by decanting or pumping liquid back to the process tank, removes excess nickel or copper sulfate and regenerates the etching solution for re-use until it become saturated again.

Periodic cycling of the solution, in this matter, allows the solution to be operated indefinitely without dumping.

The Electrchemicals NICKEL-SOL Process can also be operated continuously with a closed-loop recovery/regeneration system. This is achieved by continuously pumping the solution, at a fixed rate, through a recovery system where it is force cooled, the copper or nickel crystals separated, and the Electrochemicals NICKEL-SOL solution returned to process for further stripping.

Additional information on a continuous/regeneration system is available upon request.

Reasonable control of the Electrochemicals NICKEL-SOL solution will result in stripping consistency, economy of operation, and minimize requirements for waste treatment.

Temperature, percent sulfuric acid, and Electrochemicals NICKEL-SOL concentration are the major factors that contribute to effective bath control. Since the temperature can be regulated automatically the sulfuric acid and NICKEL-SOL I are the only factors that should concern production personnel. The concentration of both of these materials can be determined quickly and easily using the simple colorimetric titration procedures contained in this data sheet. These methods are designed so that inexperienced personnel can master them in a short time.

Maintenance chemical additions of Electrochemicals NICKEL-SOL may be made manually, but in installations where a high volume work load per gallon of Electrochemicals NICKEL-SOL solution exists, it may be more convenient to add the NICKEL-SOL I with a suitable metering pump. The stripping solution must not be allowed to siphon back into the NICKEL-SOL I drum. Contamination with the stripping solution can cause rapid decomposition of NICKEL-SOL I resulting in increased temperature and pressure within the drum which can cause the drum to rupture. Back siphoning can be effectively prevented by installing the discharge tube from the metering pump in such a way that it remains well above the surface of the stripping solution at all times.

PACKAGING

Electro-Brite CPX-II	Packaged in 50 lb fiber pails
NICKEL-SOL I	Packaged in 500 lb poly-

lined drums (approximately
50 gals,weight approximately
10 lb/gal

EQUIPMENT

Tanks, tank linings, pumps, and other equipment should be recommended by the equipment supplier as being suitable for use with sulfuric acid 20% by volume and hydrogen peroxide 15% by volume.

Most 300 Series Stainless Steel equipment may be used to handle the bath provided the bath contains a minimum of 0.5 oz/gal of copper (2 oz/gal $CuSO_4 \cdot 5H_2O$). Passivations of the equipment with nitric acid will also improve resistance to corrosion. The mixing procedure outlined in this bulletin is recommended to minimize attack on stainless steel by the hot sulfuric acid solution during make up.

Materials containing lead, tin, antimony, and bismuth or other heavy metals should NOT be used to handle the Electrochemicals NICKEL-SOL Process solution.

The following list is intended as a guide and should not be considered complete.

TANKS

Reinforced fiberglass, polyethylene, polypropylene, stainless steel (300 Series), etc.

PUMPS

Circulation and transfer - stainless steel (300 Series), Duriron and many plastic and plastic-lined pumps.

Metering - should be constructed of stainless steel (300 Series) with diaphragms and check balls made from teflon, hypalon, viton or equivalent.

Coils (heating and cooling) - 316 type "L" stainless steel, or teflon. Maximum steam pressure 10 p.s.i.

Piping - PVDC, fiberglass (reinforced) or stainless steel (300 Series), polyethylene, etc.

Valves - (plug, gate, diaphragm) - stainless steel (300 Series), polyethylene, polypropylene, steel-coated w/plastisol or other suitable plastic.

When using low temperature plastics, such as polyethylene, be aware that these materials soften at the normal operating temperature of the Electrochemicals NICKEL-SOL Process. Additional support should be provided in those cases where these materials are utilized.

CHEMICAL AND PHYSICAL PROPERTIES OF BATH INGREDIENTS

SULFURIC ACID - strongly corrosive, heavy, colorless liquid. Caution is necessary in mixing due to the evolution of much heat that can cause explosive spattering.

ELECTRO-BRITE CPX-II - white, free-flowing powder. OSHA Data Sheet available on request.

NICKEL-SOL I - clear, colorless, nonflammable liquid, weighing approximately 10 lbs/gal. Contains 50% hydrogen peroxide. OSHA Data Sheet available on request.

STORAGE AND HANDLING

Electro-Brite CPX-II compound should be stored in a cool, dry area. The material presents no particular fire or explosive hazard. Care should be taken during handling to avoid inhaling excessive quantities of the dust.

NICKEL-SOL I is shipped in specially-designed containers which have vent holes in the closures located in the upper head of the drum. These drums must be stored in the upright position at all times except when they are being emptied.

NICKEL-SOL I should be stored in a cool, dry area which is isolated from combustible material. NICKEL-SOL I is nonflammable. It is, however, a strong oxidizer and, if allowed to remain in contact with readily oxidizable organic materials, it may cause spontaneous decomposition.

Care should be exercised by operating personnel while handling this material to prevent contact with skin or other sensitive areas, such as eyes, nose, etc. Refer to caution label on each drum and the OSHA Safety Data Sheet.

NOTE: SULFURIC ACID SPECIFICATIONS

Sulfuric acid used with the Electrochemicals NICKEL-SOL Process should be electrolyte grade.

Sulfuric Acid (as H2SO4)	93.19% min by wt.
Specific Gravity at 60 F (15 C)	1.835 - 1.836

Contaminants should not exceed the below listed maximums:

Hydrochloric Acid (as HCl)	5 ppm
Nitrate (as NO3)	5 ppm
Iron (as Fe)	42 ppm

Antimony (as Sb)	1 ppm
Selenium (as Se)	20 ppm
Manganese (as Mn)	0.2 ppm
Nickel (as Ni)	1 ppm

PROCESS CONTROL

TEST: Sulfuric Acid

TEST: NICKEL-SOL I

PROCESS CONTROL

Analysis for Copper and Nickel

TEST: Copper in Electrochemicals NICKEL-SOL (When only copper is being stripped)

TEST: Analysis of Copper and Nickel in Electrochemicals NICKEL-SOL Solution (When copper and nickel are being stripped)

ELECTRO-BRITE NICKELSOL I

1. PRODUCT NAME: ELECTRO-BRITE NICKELSOL I

2. PHYSICAL AND CHEMICAL CHARACTERISTICS

   Boiling Point 226 F   Specific Gravity: 1.13

   Vapor Pressure: 23 mm Hg at 86 F

   Stable xx Yes No   Solubility in Water 100%

   Flammable : Yes xxNo   Flash Point: NA

   Extinguisher Media: NA

   Special Fire Fighting Procedures: Releases oxygen when heated.

   Appearance and Odor: Clear, colorless liquid, slightly pungent odor.

3. PHYSICAL HAZARDS

Ingredient	CAS No.	Hazard Type
Hydrogen Peroxide	7722-84-1	Oxidizer

4. HEALTH HAZARDS

Ingredient	CAS No.	Hazard Type	Exposure Limit
Hydrogen Peroxide	7722-84-1	Corrosive	1 ppm (TLV)

   Ingredients listed as carcinogens or potential carcinogens
   Ingredient CAS No. Listed By: NTP IARC OSHA
   None

   Primary Routes of Entry: Skin and eye contact; inhalation of mist.

   Signs and Symptoms of Exposure: Contact with skin and eyes can cause severe burns. Mist may cause irritation of skin, eyes and mucous membranes. Eyes are particularly sensitive, but effects can be delayed as much as a week or more after exposure.

5. EMERGENCY AND FIRST AID PROCEDURES:

   Eye: Flush with water for 15 minutes and see physician.

   Skin: Flush with water and remove contaminated clothing. Contact physician in event of irritation.

Inhalation: Remove person to fresh air. Contact physician in event of irritation of throat or nose.

Ingestion: If patient is conscious, dilute by drinking two glasses of water. Induce vomiting and obtain immediate medical attention.

6. PRECAUTIONS FOR SAFE HANDLING:

Respiratory Protection (Type): Cannister type may be required in confined areas.

Ventilation: Normally required with end use.

Eye Protection: Goggles or face shield.

Protective Gloves: Rubber or vinyl.

Other Protective Equipment: Rubber apron, boots, safety shower.

Storage Precautions: Store away from oxidizable and flammable materials and out of direct sunlight. Avoid chemical contamination in drums since contamination can cause rapid decomposition of peroxide which results in rupturing of drums.
Hazardous Decomposition Products: Releases oxygen and intensifies fires.

Incompatibility With Other Materials: Metals, dirt, oxidizable materials and organic compounds.

Steps To Be Taken In Case Of Spills Or Leaks: Dilute with large amount of water and flush to sewer or waste treatment system.

ELECTRO-BRITE CPX II A

PHYSICAL AND CHEMICAL CHARACTERISTIC

Boiling Point: NA Specific Gravity: NA

Vapor Pressure: Unknown mm Hg at

Stable: Yes Solubility in Water: 2 lb/gal

Flammable: No Flash Point: NA

Extinguisher Media: NA

Special Fire Fighting Procedures: NA

Appearance and Odor: White Powder.

PHYSICAL HAZARDS

Ingredient	Cas No.	Hazard Type
-N O N E-		

HEALTH HAZARDS

Ingredient	Cas No.	Hazard Type	Exposure Limit
-N O N E-			

Ingredients listed at carcinogens or potential carcinogens

Ingredient	Cas No.	Listed By:	NTP	IARC	OSHA
- N O N E-					

Primary Routes of Entry: Skin Contact

Signs and Symptoms of Exposure:

Prolonged exposure may cause slight, reversible irritation of skin, eyes, and mucous membranes.

EMERGENCY AND FIRST AID PROCEDURES

Eye: Flush with water for 15 minutes and contact physician.

Skin: Flush with water and remove contaminated clothing. Contact physician in event of irritation.

Inhalation: Remove person to fresh air. Contact physician in event of irritation of throat or nose.

Ingestion: If patient is conscious, dilute by drinking two glasses of water. Induce vomiting and obtain immediate medical attention.

PRECAUTIONS FOR SAFE HANDLING:

Respiratory Protection (Type):

Not normally required.

Ventilation:

No special requirements.

Eye Protection:

Splash goggles or face shield.

Protective Gloves:

Rubber or vinyl

Other Protective Equipment:

Rubber apron

Storage Precautions:

No special requirements

Hazardous Decomposition Products:

Thermal decomposition may release oxides of sulfur and nitrogen.

Incompatibility With Other Materials:

None Reported.

Steps To Be Taken In Case Of Spills or Leaks:

Flush with water to waste treatment system.

ENSTRIP C-38

Enstrip C-38 is a two-component, ammoniacal immersion stripper designed to remove copper from steel. It is especially effective in removing plated stop-off copper from heat-treated steel.* Enstrip C-38 is extremely fast, easy-to-use and cost-effective. The process exhibits the following features and benefits.

FEATURES	BENEFITS
Fast stripping rate	Increased productivity
High copper capacity	Reduces cost-per-ounce of copper stripped
Cyanide-free/chromium-free	Eliminates use of sodium cyanide and chromium; eliminates cost of waste treatment for cyanide and chromium

Enstrip C-38 strips at the rate of 4 to 6 mils of copper per hour for a fresh solution. The stripping solution can hold up to 6 to 8 oz./gal. of copper metal. The stripping rate drops off as the metal concentration increases. (See "OPERATION").

Enstrip C-38 is supplied as two liquid materials, Enstrip C-38A and Enstrip C-38B, that are mixed to make the operating solution.

HOW TO USE ENSTRIP C-38

OPERATING CONDITIONS

Concentration	
Enstrip C-38A	75% by volume
Enstrip C-38A	25% by volume
Temperature	Ambient to 77 F Maximum (25 C)
Time	As required
pH	10.0 to 10.5

NOTE: Heat treating of steel can cause changes in substrate metallurgy. In many instances it is not possible to anticipate these changes. Therefore, before the Enstrip C-38 operating solution is put into full-scale production, a few test pieces should be processed to determine their susceptibility to etching by the stripping solution.

MAKE-UP

To make up the required amount of operating solution, add 25% by volume Enstrip C-38B to 75% by volume Enstrip C-38A. Add slowly with stirring. Check pH to ensure that it is within the range of 10.0 to 10.5. DO NOT operate the Enstrip C-38 solution if pH is out of range. Raise pH with incremental additions of Enstrip C38A or 27% ammonium hydroxide.

CLEANING

If the work to be stripped has copper heat-treat scale and/or is greasy or oily, it will be necessary to clean and descale the parts. Parts must be clean to ensure that the Enstrip C-38 stripping solution wets the surface of the parts uniformly. Proceed as follows:

1. Alkaline soak clean the parts in Endox Z-576:

Concentration	12 oz/gal (90 g/L)
Temperature	180 to 200 F (82 to 93 C)
Time	3 to 5 minutes, as required

2. Cold water rinse.

3. Alkaline, non-cyanide descale in Endox 281:

Concentration	16 oz/gal. (120 g/L)
Temperature	160 to 200 F (71 to 93 C)
Time	2 to 5 minutes, as required

4. Cold water rinse.

5. Dilute acid dip in sulfuric acid in water:

Concentration	2% by volume H_2SO_4 in water
Temperature	Ambient
Time	10 to 30 seconds maximum

6. Cold water rinse.

7. Dry parts after cleaning/descaling to ensure all residual water is removed especially any entrapped water.

   NOTE: If residual water is dragged into the Enplate C-38 stripping solution, there is a danger of a localized drop in solution pH and etching of the steel.

OPERATION

The parts to be stripped may be hung on coated hooks or placed in plastic or coated baskets. Do not pack the parts so tightly together that circulation of the solution around them is prevented. Shake basketful of parts occasionally to change contact areas and permit uniform stripping. If parts are to be stacked in the tank, they should be kept off the bottom of the tank by the use of plastic slats or some other arrangement.

Otherwise, the solution will become stagnant, or in aged solutions, precipitated metal salts may cover the parts on the bottom and cause etching of the steel. Rapid stripping of small parts can be done in an oblique, open-end tumbling barrel; speed of barrel rotation will have little effect on the stripping rate and should be determined by the shape and size of the parts.

Enstrip C-38 chemically strips by immersion. Merely immerse the plated work in the stripping solution until the copper has completely dissolved. Agitation of the work or operating solution will increase the stripping speed. Maintain the operating temperature below 77 F. (25 C). pH should be maintained between 10.0 and 10.5. Periodically check pH to ensure it is within the recommended range. If adjustment is required, add Enstrip C-38A or 27% ammonium hydroxide in small increments until the pH is within range.

To minimize substrate metal loss and the potential for etching, parts should be removed from the solution as soon as they are completely stripped and rinsed thoroughly in cold, running water for 30 to 60 seconds. It is recommended that a water displacing liquid such as WDL No. 1 or rust preventive oil such as Entek RPO-22 be applied to the parts after rinsing.

The stripping rate decreases as the copper content of the operating solution increases. The graph illustrates a typical solution life cycle. NOTE: Even as the solution approaches saturation level of 6 to 8 oz./gal. (45 to 60 g/l), the stripping rate is still approximately one mil/hr.

EQUIPMENT

Enstrip C-38 solutions may be contained in Koroseal-lined, polypropylene or PVC tanks. Work holders, baskets, and racks should be coated steel or Plastisol. Do not use lead-lined tanks, lead coils or solder or brazed joints below solution level. If cooling coils are used they should be made of teflon. Copper hooks and work holders will dissolve in the stripping solution. Exhaust ventilation should be sufficient to remove mist or fumes that may be generated during make-up and operation. Excessive ventilation will result in excessive loss of ammonium hydroxide.

CONTROL

The operating solution may be controlled by pH analysis and the following "ANALYSIS FOR COPPER" for most applications. pH should be maintained between 10.0 and 10.5. Periodically check pH to ensure it is within the recommended range. If adjustment is required, add Enstrip C-38A for 27% ammonium hydroxide in small increments until the pH is within range.

CAUTION: The following procedures involve the use of potentially hazardous chemicals; manufacturer's operating instructions should be consulted and the appropriate safety cautions followed.

REPLENISHMENT

As the copper metal content approaches 8 oz./gal (60 g/l), the Enstrip C-38 stripping solution is near exhaustion. A new Enstrip C-38 stripping solution should be made up.

WASTE TREATMENT

Spent Enstrip C-38 operating solutions contain ammonia and copper/ammonia complexes. Consult local agencies with regard to regulations concerning disposal of copper and ammonia-containing wastes. A detailed waste treatment procedure is available from Enthone.

PRECAUTIONARY INFORMATION

DANGER: ENSTRIP C-38 CONTAINS SODIUM CHLORITE AND AMMONIUM HYDROXIDE.

HAZARDS: Enstrip C-38A contains ammonium hydroxide and is alkaline in nature. Enstrip C-38B contains sodium chlorite, a strong oxidizing agent. Contact of Enstrip C-38A, C-38B or the operating solution may cause irritation or burns to the skin and eyes. Inhalation or ingestion may cause respiratory tract and gastrointestinal irritation and burns.

FIRST AID: In Case of contact of Enstrip C-38A, Enstrip C-38B or the operating solution with skin or eyes, flush with plenty of clean, cool water for 15 minutes; for eyes get immediate medical attention. Remove contaminated clothing and shoes and wash before reuse.

HANDLING INFORMATION: When preparing or adding to solutions, always wear goggles, face shield, rubber gloves, respirator and protective clothing.

Enstrip C-38B and the Enstrip C-38 operating solution contain sodium chlorite and should not be allowed to come in contact with organic materials such as sawdust, paper, cloth, oil, and must

not be allowed to come in contact with any chemical reducing agents such as sulfur, phosphorus, or sulfides because of the possibility of explosion or fire.

Acid must never be mixed with the Enstrip C-38B or the Enstrip C-38 operating solution because chlorine dioxide, a poisonous and explosive gas, may be evolved. Do not allow the Enstrip C-38 operating solution to evaporate and form dry salts which may be shock-sensitive and detonate on impact. Any spillage of solution should be immediately wiped up or flushed thoroughly with water into an approved container or drain.

Exhaust ventilation is recommended to remove fumes that may be generated during make-up and operation.

CONTAINER INFORMATION: Keep containers tightly closed. Store indoors in a cool, dry area. Do not reuse containers. Wash thoroughly before disposal.

ENSTRIP EN-79

FEATURES	BENEFITS
Strips high-phosphorus (8 to 14% by weight) electroless nickel deposits up to 5 mils thick	Saves production time
Strips heat treated electroless nickel from steel parts and/or parts used in the field; also strips from copper and copper alloys	Reduces number of stripping solutions required; saves warehousing and inventory costs
Cyanide-free process; contains no ammonia	Eliminates sodium cyanide; eliminates cost of waste treatment to destroy cyanide and problems associated with ammonia

Enstrip EN-79 is a non-cyanide, alkaline stripper that dissolves high-phosphorus, electroless nickel deposits up to 5 mils thick from steel by immersion. It may also be used to strip electroless nickel deposits from copper and copper alloys and to strip heat treated electroless nickel from steel parts or parts that have been used in the field. Enstrip EN-79 is NOT recommended for stripping electroless nickel deposits from assemblies containing manganese, nickel, cobalt, cadmium, zinc, aluminum, or molybdenum.

Enstrip EN-79 is supplied as two components: Enstrip En-79A, a liquid material and Enstrip En-79B, a powder. Both components are combined with sodium hydroxide and water to make-up the operating solution. In addition, Enstrip Regenerator, a liquid material, may be require to replenish the bath inhibitors and accelerators under certain circumstances.

Prior to using this product, refer to the "MAKE-UP," "OPERATION," and "CAUTION" sections for proper handling and usage procedures. Read entire data sheet before using this product.

HOW TO USE ENSTRIP EN-79

OPERATING CONDITIONS

Concentration

Enstrip En-79A	50% by volume
Enstrip EN-79B	8 oz./gallon (60 g/l)

Sodium hydroxide	2 oz./gallon (15 g/l)
Water	As required
Temperature	190 to 195 F. (85 to 91 C)
Optimum	190 F. (85 C)
Time	As required.

MAKE-UP

To make up 100 gallons of operating solution, proceed as follows; add ingredients in the order listed.

1. Add 40 gallons of warm water, 110 F. (43 C) to the operating tank.

2. Add 50 lb. of Enstrip En-79B and stir until completely dissolved.

3. Cautiously add 50 gallons of Enstrip En-79A.

4. Cautiously add, with stirring, 12-1/2 lb. of sodium hydroxide and continue stirring until completely dissolved.

5. Fill to final volume with water and heat to operating temperature of 190 to 195 F. (85 to 91 C); optimum operating temperature of 190 F. (85 C)

NOTE: When preparing or adding to solutions, always add sodium hydroxide slowly and in small amounts to avoid violent boiling and spattering. Hot water must not be used. Eyes, face, neck, and hands must be protected and respiratory protection may be necessary.

GENERAL OPERATION

Parts to be stripped should be cleaned in an alkaline cleaner. Remove all chromium deposits with either a hydrochloric acid dip or an Enbond alkaline reverse current electrolytic cleaner. If an alkaline electrolytic cleaner is used, the parts should be immersed in a 30 to 50 percent by volume hydrochloric acid solution for one minute to activate the nickel surface. This will accelerate the initial stripping rate and promote uniform stripping of the nickel. Follow with a running water rinse; then immerse the parts in the Enstrip EN-79 operating solution.

Electroless nickel deposits tend to passivate readily. Therefore, parts should be dipped in a 30 to 50 percent by volume hydrochloric acid solution for one minute to activate the nickel surface prior to stripping. Follow with a running water rinse; then immerse the parts in the Enstrip En-79 operating solution.

Exhaust ventilation is recommended.

Suspend the rack or basket of parts to be stripped into the Enstrip EN-79 solution. Do not allow the parts to touch the bottom or sides of the tank or come in contact with the heating coils. For most efficient stripping, immerse as many parts as possible in the Enstrip EN-79 solution. Mechanically agitate the work or solution to avoid localized overheating. DO NOT use air agitation. Remove all parts from the operating solution as soon as they are fully stripped.

Keep the stripping tank covered at all times. Prolonged heating of the solution without a cover will result in some loss of Enstrip EN-79A. This loss must be replaced if efficiency is to be maintained (refer to section entitled "CONTROL"). Avoid prolonged heating of the solution when it is not in use. Solutions of Enstrip En-79 that no longer strip the electroless nickel deposit by dissolving, but rather "peel off" the deposit from the substrate, will also require additions of Enplate EN-79A as outlined under "CONTROL".

Ensure that copper, lead, chromium and cadmium salts and metals are not introduced into the Enstrip EN-79 solution. Contamination of the solution with these metals or salts will lower the stripping efficiency. New and used Enstrip En-79 solutions MUST NOT be heated for long periods without immersing nickel-plated parts into the solution. Metallic and organic contamination or heating without stripping electroless nickel deactivates the accelerators in the Enstrip EN-79 solution.

STRIPPING ELECTROLESS NICKEL FROM STEEL

Steel substrates should be clean and free from any residual smut once all the electroless nickel deposit has been stripped. A warm water rinse should be used subsequently to remove any residual Enstrip En-79 solution from the parts, especially from holes and crevices.

Enstrip En-79 is formulated to be selective in stripping electroless nickel from most steel substrates. However, some high alloy (e.g. carbon, nickel, chromium, molybdenum) or case-hardened and nitrided alloys may be susceptible to attack. Before stripping electroless nickel deposits from these substrates, a few test pieces should be processed in the Enstrip En-79 operating solution to determine their susceptibility to attack by the stripping solution.

STRIPPING ELECTROLESS NICKEL FROM COPPER AND COPPER ALLOYS

Electroless nickel deposits on copper and copper alloys must be continuous. Any areas of exposed copper or copper alloy must be masked by applying a suitable stop-off before stripping the electroless nickel deposit in Enstrip EN-79, otherwise a discoloration or etch may occur on the exposed substrate after all the electroless deposit has been stripped.

Before stripping electroless nickel from copper substrates or assemblies with copper alloy brazings, a few test pieces should be processed in the Enstrip EN-79 operating solution to determine their susceptibility to attack by the stripping solution.

Copper or copper alloy substrates will have a residual dark film or protective layer after all the electroless nickel has been stripped. The dark film is easily removed by one of three methods:

1. Dip the parts in a solution containing Endox 114 at 1 lb./gal. (120 g/l) and sodium hydroxide at 1 lb./gal.

   (120 g/l) at 100 F (38 C) with periodic reverse current.

   Operate at approximately 8 seconds anodic/4 to 5 seconds cathodic.

OR

2. Dip the parts in a solution containing 4 to 16 oz./gal. (30 to 120 g/l) of sodium cyanide.

OR

3. Dip the parts in a solution containing 4 to 8 oz./gal. (30 to 60 g/l) of chromic acid.

In all cases, removal of the dark film is easiest when it is not allowed to dry on the work.

STRIPPING RATE

The stripping rate of Enstrip En-79 will vary depending upon the thickness of the elctroless nickel deposit, the percentage of phosphorus in the deposit, the age of the deposit and/or if the deposit has been heat-treated, the concentration of nickel metal dissolved in the stripping solution, and the operating temperature. A new operating solution of Enstrip En-79 will strip a fresh electroless nickel deposit of 1.0 mil (25.4 microns) containing approximately 10 percent phosphorus in about 2 to 4 hours. Stripping rates for other deposits will vary accordingly. Deposits up to 5 mils thick have been stripped using Enstrip En-79.

The life of the Enstrip EN-79 operating solution is dependent upon the method and conditions of operation. Solutions of Enstrip En-79 operated according to the recommended procedures will dissolve between 2 to 4 oz./gal. (15 to 30 g/l) of nickel metal.

REPLENISHMENT

Enstrip En-79 solutions can be replenished to provide maximum efficiency and economy. Depending on usage and conditions of operation, the solution should be analyzed and replenished AT LEAST once a week.

Replenishment additions of 1 to 2 oz./gal. (7.5 to 15 g/l) of sodium hydroxide should be made after stripping 5 to 10 mil/ft2 of elctroless nickel per gallon of solution (82.5 to 165 micron/dm2 per liter). To eliminate the danger of eruption due to the heat of solution of the powder, do not add sodium hydroxide powder directly to the hot stripping solution. Slowly and carefully, with constant stirring, dissolve the required amount of sodium hydroxide in cold water. Wear rubber gloves, faceshield, and protective clothing when dissolving the sodium hydroxide. Slowly and carefully add the sodium hydroxide solution to the stripping solution.

The Enstrip EN-79A concentration should be replenished to 50% by volume of the operating solution. For each 10% by volume low in Enstrip EN-79A as indicated by analysis, add 2 oz./gal. (15 g/l) Enstrip EN-79B and 1 oz./gal. (7 1/2 g/l) sodium hydroxide.

In all cases, the analysis for Enstrip En-79A and replenishment of Enstrip En-79A, Enstrip En-79B, and sodium hydroxide should be followed by an analysis and replenishment of Enstrip Regenerator as outlined under "CONTROL".

EQUIPMENT

Tanks made os steel are recommended for operating solutions of Enstrip En-79. The size of the tank is important; the tank should be deep enough to allow a maximum clearance between the bottom of the parts being stripped and the bottom of the tank to allow for any sludge accumulations.

Direct heating can be accomplished using plain steel or Teflon electric heaters or Platecoils. Racks, hooks, baskets, mixer shafts and propellers should be made of steel. Shafts and propellers should be plastisol-coated. DO NOT USE BRASS OR COPPER RACKS, HOOKS OR BASKETS. DO NOT use air agitation. Mechanical agitators having Plastisol-coated shafts and propellers are recommended. Exhaust ventilation is recommended.

The parts to be stripped, heating coils, and mixer must be electrically insulated from the tank. All other equipment such as mechanical agitators and temperature sensors in contact with the stripping solution must be free from any stray potential current capable of setting up a galvanic cell within the stripping solution.

CONTROL

The following procedures are recommended for analyzing and replenishing the Enstrip EN-79 operating solution. Perform the analyses in the order given.

ANALYSIS FOR ENSTRIP EN-79A

APPARATUS NEEDED

5 ml pipette
50 ml burette
250 ml beaker
250 ml Erlenmeyer flask
Filter paper, Whatman #41

REAGENTS NEEDED

1% methyl orange indicator solution - dissolve 1 gram of methyl orange salt in 100 ml of deionized or distilled water.

1.0N sulfuric acid (H_2SO_4) solution - purchase from local laboratory supply house.

PROCEDURE

1. Adjust the volume of the Enstrip En-79 operating solution to volume at original make-up by adding water. Mix well.

2. Take a 150 ml sample of the adjusted operating solution, cool to room temperature and filter to remove particulate matter.

3. Pipette a 5 ml aliquot of the filtered solution into an Erlenmeyer flask and add 75 ml of deionized or distilled water and several drops of 1% methyl orange indicator solution.

4. Using a white background, titrate to the endpoint using 1.0N H_2SO_4 solution; color change is from yellow to pink.

CALCULATION

ml H_2SO_4 titrated x Normality H_2SO_4=Factor A

Consult Graph I to determine percent by volume Enstrip EN-79A.

REPLENISHMENT

Restore solution to original make-up of 50% by volume Enstrip En-79A; for each 10% by volume Enstrip EN-79A replenished, add 2 oz./gal (15 g/l) Enstrip En-79B and one oz./gal. (7 1/2 g/l) sodium hydroxide.

ANALYSIS FOR ENSTRIP REGENERATOR

The amount of Enstrip Regenerator required for replenishment is determined by a visual comparison of the Enstrip En-79 operating solution against several color standards.

APPARATUS NEEDED

1 ml pipette - graduated in 0.1 ml units
2 ml pipette - dropper type
5 ml pipette - graduated in 0.50 ml units
10 ml pipette
10 ml graduated cylinder
100 ml volumetric flask (2 required)
1 liter volumetric flask
20 ml test tubes, stoppered (7 required)
White background

REAGENTS NEEDED

Copper sulfate solution - add 5 ml of ammonium hydroxide (NH_4OH) to 75 ml of water and dissolve 1.5 grams of copper sulfate pentahydrate ($CuSO_4.5H_2O$) in the mixture. Add water to bring to exactly 100 ml. ENSURE THAT CHEMICALS ARE ADDED IN ORDER GIVEN OR A SOLID WILL PRECIPITATE.

1, 1, 2 - trichlorethylene or 1, 1, 2 trichlorethane - purchase from local laboratory supply house.
Standard Enstrip Regenerator solution - into a one liter volumetric flask add 0.70 ml of Enstrip Regenerator and dilute to exactly one liter with water.

PROCEDURE

1. Number the test tubes 1 through 7.

2. Into each test tube place 10 ml of trichlorethylene or trichlorethane and 2 ml of copper sulfate solution. This results in the formation of two layers, blue on top and clear on the bottom.

3. Make the following additions to test tubes 1 through 6.

Test Tube No.	ml of diluted Standard Enstrip Regenerator Solution
1	None
2	1.0
3	1.5
4	2.0
5	2.5
6	3.0

4. Stopper each test tube and shake well. The bottom layers will take on varying shades of amber yellow, the top will remain blue.

5. Take a 150 ml sample of the Enstrip EN-79 operating solution. Ensure that the operating solution has been adjusted to recommend concentration of Enstrip EN-79A, EN-79B, and sodium hydroxide as outlined under "ANALYSIS for Enstrip EN-79A."

6. Allow sample to cool to room temperature; then filter to remove particulate matter.

7. Pipette 10 ml of the filtered EN-79 operating solution into a 100 ml volumetric flask and dilute to exactly 100 ml.

8. Pipette 1 ml of the diluted Enstrip EN-79 operating solution into test tube number 7; stopper and shake well.

9. Using a white background, compare the amber yellow color of the bottom layer of test tube number 7 against color standards number 1 through 6.

10. Use Graph II to determine the amount of Enstrip Regenerator to add to the Enstrip EN-79 operating solution.

WASTE TREATMENT

Enstrip EN-79 is an alkaline solution and must be neutralized to a pH of about 8.0 after treatment for nickel metal and prior to disposal into a sewage system. Consult appropriate environmental agencies for nickel ion concentration limits in treated effluent. A detailed waste treatment procedure is available from Enthone's technical service department on request.

CAUTION...

Enstrip EN-79A, Enstrip EN-79B, and the stripping solution should be handled with care and proper protective closting such as respirator, rubber gloves and chemical safety glasses, should be worn to prevent contact with the skin or eyes. Do not inhale dust or mist from the bath components or from the operating solution. Exhaust ventilation is recommended to remove dust or fumes that may be generated during make-up and operation. Enstrip EN-79A, and the Enstrip EN-79 operating solution are strongly alkaline in nature and may cause skin and eye burns. Enstrip EN-79B may cause irritation and burns to skin and eyes. Avoid skin and eye contact. In case of contact, flush skin and eyes with plenty of cool, clean water for 15 minutes; for eyes, obtain immediate medical attention. Enstrip EN-79B is calssified as "flammable solid N.O.S." per U.S. Department of Transportation regulations. Do not store near excessive heat or open flames. Do not mix Enstrip EN-79B and dry sodium hydroxide together as this may cause autoignition.

ENSTRIP GT-317

Enstrip GT-317* is a stablilized, acidic stripper for removing plasma flame sprayed and D-gun tungsten carbide coatings from titanium, steel and stainless steel substrates.

Enstrip GT-317 strips the following coatings: UCAR-LW IN40 (PWA 46, G.E. F 50T19D), UCAR LW-IN30 (PWA 52, G.E. F 50T19E), Metco 63 and 63 NS (PWA 1313).

Enstrip GT-317 also strips flame sprayed molybdenum coatings: UCAR LM-6A (PWA 53-13, G. E. B 50TF41), UCAR LW-11B (PWA 53-1), Metco 63 and 63 NS (PWA 1313).

Enstrip GT-317 is approved for stripping PWA 46 and PWA 52 coatings; consult Pratt and Whitney Overhaul Standard Practices Manual SPOP 317, Stripping of Plasma Coating Method L.

Enstrip GT-317, a liquid material, is supplied as a three-component system: Enstrip GT-317A, GT-317B used for both make-up and replenishment, and Esntrip GT-317C used for make-up only.

HOW TO USE ENSTRIP GT-317

OPERATING CONDITIONS

Concentration

Enstrip GT-317A	50% by volume
Enstrip GT-317B	20% by volume
Enstrip GT-317C	5% by volume
Water	25% by volume

Operating Temperature	70 to 90 F (21 to 32 C).
Optimum	80 F (26 C)
Time	As Required

*Patent Pending

MAKE-UP

BE SURE TO ADD THE COMPONENTS IN THE ORDER GIVEN.

1. Fill the tank to slightly less than 25% by volume with tap water.

2. Slowly add the required amounts of Enstrip GT-317A, GT-317B and GT-317C while stirring, making certain that large quantities are not added at one time.

3. Fill the tank to final volume with water.

4. Check to determine if solution temperature is within the operating temperature range of 70 to 90 F. 2 to 32 C.

OPERATION

Enstrip GT-317 solution is designed to operate by immersion with or without mechanical agitation. Mechanical agitation of the stripping solution will increase the stripping rate.

Prior to any metal stripping operation, proper cleaning and activation of the component is necessary. Parts must be thoroughly cleaned of oils, grease or wax, and nickel electrodeposits should either be stripped or masked prior to immersion in Enstrip GT-317 solutions.

Parts or components to be stripped should be completely immersed into the Enstrip GT-317 solution. Do not allow any portion of the component being stripped to protrude above the solution level. All parts or components should be individually racked and should not be allowed to contact one another.

An operating temperature of 26C (80 F) for a working solution of Enstrip GT-317 is recommended. Temperatures less than 26C (80 F) greatly reduce the stripping rate, whereas temperatures greater than 32C (90 F) cause excessive Enstrip GT-317B component depletion.

The stripping of Al, Mg, An, Cd, Sn, Pb, Cu, Ag and their alloy will cause rapid decomposition and malfunction of the Enstrip GT-317 solution. Baths contaminated with sufficient amounts of these elements cannot be rejuvenated and must be appropriately discarded.

STRIPPING RATE

The ease with which hard surface coatings are stripped is primarily determined by the coating's chemical composition, porosity and service history. Improved stripping rates are realized when solution or workpiece agitation is employed and/or higher operating temperatures used.

Tungsten carbide coatings are typically stripped by Enstrip GT-317 solutions at a rate of three mils per hour. Tungsten carbide-titanium carbide coatings require about one hour for removal of 1.5 mils, UCAR WT-1 and twice this time for an equal thickness of UCAR WT-2.

EQUIPMENT:

Tanks constructed of polyethylene, polypropylene or polyvinyl chloride, minimum wall thickness one-quarter inch, are suitable for containing Enstrip GT-317 solutions.

Provision for heating and cooling the solution is necessary. A DuPont Teflon supercoil or Lufran Teflon Exchanger is recommended for this purpose.

Solution agitation can be carried out with a Lightening Mixer fitted with a Plastosol-coated propeller and shaft. More detailed recommendations will be made upon request by Enthone's Equipment Services Department.

Exhaust ventilation is recommended to remove fumes and vapors that may be generated during make-up and operation.

ANALYSIS AND CONTROL PROCEDURES

Enstrip GT-317 operating solutions can be replenished to provide maximum efficiency and economy. Operating solutions of Enstrip GT-317 must be analyzed prior to use. Daily analyses should be carried out and additions made as required to insure optimum performance and operation.

ANALYSIS FOR ENSTRIP GT-317A

Apparatus Needed:

5 ml pipette
250 ml Erlenmeyer Flask
50 ml burette

Reagents Needed:

1% phenolphthalein indicator solution: dissolve 10g of phenolphthalein powder in 500 ml of methanol and dilute to one liter.

1.00 N sodium hydroxide solution (NaOH): dissolve 40.0g of NaOH in deionized or distilled water and dilute to 1 liter in a volumetric flask.

Procedure:

1. Pipette a 5 ml sample of the working solution into a 250 ml Erlenmeyer flask.

2. Add approximately 50 ml of deionized water and several drops of the phenolphthalein indicator solution.

3. Titrate contents of the flask with 1.00 N sodium hydroxide solution to a faint pink endpoint.

Calculation:

Enstrip GT-317A Volume % = ml NaOH x Normality NaOH x 3.9

Replenishment:

Normal concentration is 30 to 50% by volume. For every 10% by volume below optimum concentration add 25.6 fl. oz./gal. of Enstrip GT-317A.

ANALYSIS FOR ENSTRIP GT-317B

Apparatus Needed

5 ml pipette
10 ml Pipette
100 ml volumetric flask
250 ml Erlenmeyer flask
50 ml burette

Reagents Needed:

0.100 N. sodium thiosulfate : purchase

Potassium Iodide crystals(KI): purchase

10% volume sulfuric acid solution (H_2SO_4) : carefully with stirring, add 100 ml concentrated A.R. grade H_2SO_4 to about 500 ml H_2O. Cool and dilute to one liter with H_2O.

Starch Indicator Solution : purchase

Procedure:

1. Pipette 10 ml of a working solution into a 100 ml volumetric flask and dilute to 100 ml with deionized water.

2. Pipette 5 ml of the diluted working solution into a 250 ml Erlenmeyer flask.

3. Add 5 to 10 ml of 10% H_2SO_4 solution to the Erlenmeyer flask.

4. Add about one gram of KI crystals and mix to dissolve. Let stand 1 to 2 minutes.

5. Titrate the iodine formed, using a starch indicator, with a 0.100 N sodium thiosulfate solution to a colorless endpoint.

Calculation:

Enstrip GT-317B concentration volume % =

ml Na2S2O3 x Normality Na2S2O3 x 5.7

Replenishment:

Normal concentration is 25 to 25% by volume. For every 5% by volume below optimum concentration add 6.5 fl. oz./gal. of Enstrip GT-317B.

WASTE TREATMENT

Store spent Enstrip GT-317 solutions in a vented container or open tank. To prevent rapid solution heating, Enstrip GT-317 solutions should be diluted with water prior to cautious addition of alkali.

Consult State and Local Environmental Agencies concerning discharge limits of treated effluent and disposal of accompanying sludge generated by this waste treatment process.
A detailed waste treatment bulletin will be made available to Enthone customers upon request. Please contact your Enthone sales engineer or Enthone's Technical Service Department.

CAUTION:

Enstrip GT-317A and Enstrip GT-317C are acidic. Enstrip GT-317B contains hydrogen peroxide and is a strong oxidizing agent which is strongly corrosive. Operating solutions of Enstrip GT-317 are strongly acidic. Each of the components of Enstrip GT-317 and its operating solution may cause severe eye and skin burns.

Avoid any contact with skin, eyes and clothing. When handling Enstrip GT-317A, B, and C, wear faceshield, rubber gloves, protective clothing and rubber footwear. When making up the operating solution, careful follow the instructions for make up.

In case of contact of Enstrip GT-317A, B, C, or the operating solution with eyes or skin, flush with large amounts of cool, clean water for 15 minutes; for eyes, get immediate medical attention. Contaminated clothing should be removed and washed before reuse.

Enstrip GT-317B contains 50% hydrogen peroxide and is a strong oxidizer. Store in a cool, dry place away from heat, sparks or open flames. Exposure of hydrogen peroxide containers to sources of heat may result in decomposition of the peroxide to water and oxygen which can rupture even a vented container with explosive violence. Such reactions can also be cause by contamination with metals or metal salts. Keep away from combustible materials such as wood, sawdust, paper, cloth and with chemical reducing agents and organic materials.

ENSTRIP S-180

Benefits of Using Enstrip S-180

Properties	Benefits
Cyanide-free process.	Eliminates the use of costly sodium cyanide; eliminates cost of waste treatment to destroy cyanide.
Strips nickel, nickel-iron, nickel sulfamate, and copper	Reduces inventory requirements.
Will not decompose on standing. and can be used over long periods of time; no pH control required.	Economical and easy to operate.

Enstrip S-180* is a non-cyanide, alkaline stripper that removes nickel, nickel sulfamate, copper, and nickel-iron deposits containing 15 percent or less iron content from steel by immersion. By adding Enstrip S-180 Additive to the operating solution the bath may also be used to strip nickel-iron deposits containing more than 15 percent iron. Enstrip S-180 Additive prevents precipitation of iron from the operating solution and minimizes the residual smut after stripping nickel-iron deposits.

Enstrip S-180 strips nickel, nickel sulfamate, and nickel-iron at an initial rate of 0.7 to 1.0 mil/hr. (18 to 25 microns/hr.) and copper at an initial rate of 0.5 mil/hr. (13 microns/hr.) for a new bath.

Enstrip S-180 is not recommended for stripping nickel, nickel sulfamate, nickel-iron, or copper deposits from aluminum, zinc, and brass substrates since these metals are attacked by the stripping solution. Brazed areas of steel substrates will also be attacked.

Enstrip S-180 is supplied as follows: Enstrip S-180A is a liquid material, Enstrip S-180B is a powdered material and Enstrip S-180 Additive is a powdered material.

*Covered by U. S. Patent No. 3,717,520.

HOW TO USE ENSTRIP S-180

OPERATING CONDITIONS

Concentration

Enstrip S-180A	20 fl.oz./gal. (156 mil/liter)
Enstrip S-180B	20 oz./gal. (150 g/liter)

Enstrip S-180 Additive (for nickel-iron deposits containing more than 15% iron)	4 oz./gal. (30 g/liter)
Water	To final volume
Temperature	140 to 160 F. (60 to 71 C)
Time	As required

MAKE-UP

To make-up a new Enstrip S-180 operating solution, proceed as follows:

1. Fill the tank to 60% final volume with water and heat to 140 F. (60 C).

2. Add 20 fl. oz./gal. (156 ml/liter) Enstrip S-180A and mix thoroughly.

3. Reheat to 140 F. (60 C) while stirring.

4. Add 20 oz./gal. (150 g/liter) Enstrip S-180 and stir until completely dissolved.

   NOTE: For stripping nickel-iron deposits containing more than 15% iron, also add 4 oz./gal. (30 g/liter) of Enstrip S-180 Additive and stir until completely dissolved.

5. Add water to final volume and heat to operating temperature.

OPERATION

When stripping nickel-iron deposits containing more than 15 percent iron, be sure to add the Enstrip S-180 Additive to the operating solution before any work has been stripped.

All work must be precleaned in a suitable cleaner such as Enbond S-74 or Enbond Q-527; this procedure reduces contamination of the stripping solution and promotes uniform stripping of nickel and copper plate.

If the nickel, nickel sulfamate, nickel-iron, or copper surface is aged and thereby passive, an immersion or cathodic activation in Actane 82 or Actane 83 is recommended. This will promote uniform stripping of the metal deposits.

Enstrip S-180 strips by single immersion. Merely immerse the plated work in the stripping solution until the plate has completely dissolved.

The work may be hung on steel or stainless steel hooks or placed in baskets of steel, stainless steel, or plastic. However, do not pack the parts so tightly together that circulation of the solution around them is prevented. Shake basketful of parts occasionally to change contact areas and permit uniform stripping. If parts are to be stacked in the tank they should be kept off the bottom of the tank by the use of slats or some other arrangement; otherwise the solution will become stagnant, or in an old bath, precipitated metal salts may cover the parts on the bottom and cause etching of the steel. The stripping rate can be increased appreciably by agitation of the parts or by barrel stripping at the higher temperatures not to exceed 160 F. (71 C).

For stripping nickel, nickel sulfamate, or nickel-iron, the solution operates most effectively at elevated temperatures; the most rapid stripping rate is obtained at 140 to 160 F (60 to 71 C). Conversely, stripping or nickel may be done at lower temperatures but with an increase in stripping time. For stripping copper, the solution may be operated at 75 to 140 F. (24 to 60 C). If the temperature of the solution exceeds 160 F. (71 C), etching of the basis metal may occur. Avoid high temperature heat sources that are in direct contact with the solution. Constant agitation may be necessary to avoid localized overheating (See "Equipment").

At a temperature of 140 F. (60 to 71 C), Enstrip S-180 solutions strip nickel, nickel sulfamate, and nickel-iron at an average rate of 0.6 mil/hr. (15 microns/hr.) and copper at an average rate of 0.3 mil/hr. (7 1/2 microns/hr.). The average stripping capacity of the solution is 80 ft.2 per 0.1 mil deposit per gallon of operating solution (2 m2 per 0.67 micron deposit per liter of operating solution).

EQUIPMENT

Enstrip S-180 solutions should be contained in PVC lined steel, or polypropylene containers. Steel, stainless steel, or quartz heat exchangers are recommended; avoid high temperature heat sources that are in direct contact with the stripping solution. Wires, baskets, barrels, or racks of steel or stainless steel may be used to hold the work in the Enstrip S-180 solution. Ensure that the work, suspension bar, heater and mixer are insulated from the solution tank. This will eliminate a potential source of internal galvanic action that may result in etching of the parts being processed.

Be sure that the tank containing the solution is insulated from any stray electrical currents emanating from heaters or stirrers. Such stray currents will set up a galvanic cell in the solution resulting in etching or pitting of the parts and/or tank.

Solution agitation with a mechanical stirrer is recommended to avoid localized overheating. The stirrer should be plastisol coated.

Exhaust ventilation is required to removed ammonia gasses that are formed in the initial stage of the stripping process. These gases will dissipate as the stripping process continues.

CONTROL

It is recommended that the bath be used to exhaustion without replenishment additions; when the stripping time become excessive, the Enstrip S-180 solution should be discarded (see "WASTE TREATMENT") and a new solution should be prepared. Add water to the solution when required to replace loss in bath volume due to evaporation.

WASTE TREATMENT

Enstrip S-180 is an alkaline solution and must be neutralized before disposal into a sewage system. Cautiously neutralize the spent solution with 25% sulfuric acid to a pH of about 8.0.

Discharge the solution into the sewage system, using copious amounts of water for dilution.

Consult local agencies for regulations governing waste effluent disposal, especially with respect to nickel, iron, and copper. A suggested detailed procedure for disposition of copper and nickel in spent Enstrip S-180 solutions is available from Enthone upon request.

CAUTION....

The Enstrip S-180 solution is strongly alkaline and oxidizing in nature and the usual precautions for handling such materials should be taken. Use rubber gloves, safety glasses, and protective clothing when handling the solution or its components. Avoid contact of the Enstrip S-180 solution or its components with the skin or eyes. In the event of contact, flush skin or eyes with plenty of cold water; for eyes, obtain medical attention after flushing with water. ENSTRIP S-108B salts and the Enstrip S-180 solution are strong oxidizing materials. Therefore, contact with organic materials such as paper, wood, or sulfur should be avoided.

ENSTRIP N-190

SECTION II - HAZARDOUS INGREDIENTS

NONE

Hazardous Mixtures of Other Liquids, Solids or Gases

	%	TLV (Units)
Amine	< 50	25 mg/M3
Thio compound	< 5	

SECTION III - PHYSICAL DATA

Boiling Point:	231 F.	Specific Gravity:	1.01
Vapor Pressure (mm Hg):	20 mm Hg	% Volatile by Vol:	NA
Vapor Density (Air=1):	NA	Evaporation Rate:	NA
Solubility in Water:	Very Soluble		
Appearance and Odor:	Clear to very light yellow liquid with ammoniacal odor.		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: *None* Flammable Limits: NA

Extinguishing Media: In a Fire: Water

Special Fire Fighting Procedures: NA

Unusual Fire and Explosion Hazards: NA

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value: NA

Effects of Overexposure: Rapidly damaging to skin and mucous membrane. This product may cause dermatitis.

Emergency and First Aid Procedures:

External: Wash with much water: for eyes also get immediate medical attention.

Internal: Do not induce vomiting. Swallow vinegar water, drink much water; report to doctor.

Inhalation: Remove to fresh air. Apply artificial respiration and oxygen if necessary. Get immediate medical attention.

SECTION VI - REACTIVITY DATA

Stability: Stable; Shelf Life: 1 year.

Incompatibility: Acids, oxidizers

Hazardous Decomposition
Products:

in a fire - NH_3, N_2, possibility of toxic CO, CO_2 nitrogen oxides.

Hazardous Polymerization: Will not occur.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps To Be Taken in Case Material is Released or Spilled:

Avoid contact with skin, eyes and clothing. In case of contact, flush with water for 15 minutes Avoid breathing fumes which are hazardous. Stay upwind.

Waste Disposal Method for Spills and Leaks:

Minor: Flush away with water.

Major: Contain spill. Collect liquid or absorb on soda ash, sand, etc. Shovel up into container for disposal. After cleanup, flush area with water to remove residue. If spill reaches sewer or stream, notify proper authorities. Take liquid or absorbent to chemical waste treatment facility for neutralization of alkalinity.

For Waste Treatment of Operating Solution:

Consult Enthone Operating Instructions.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Respiratory Protection: Type for ammonia/amines

Ventilation: Local Exhaust: Yes if general area ventilation is poor.

Protective Gloves: Yes, rubber

Eye Protection: Yes, goggles

Other Protective Equipment:

Respiration may be required if ventilation is poor, or for extended exposure.

SECTION IX - SPECIAL PRECAUTIONS

Precautions To Be Taken in Handling and Storing:

Keep closed. Store at minimum of 40 F. and maximum of 110 F.

Other Precautions:

Avoid skin contact.

ENSTRIP 190-B

SECTION II - HAZARDOUS INGREDIENTS

NONE

Hazardous Mixtures of other Liquids, Solids, or Gases

No known hazardous ingredients

SECTION III - PHYSICAL DATA

Boiling Point (F):	sublimes	Specific Gravity (H2O=1):	NA
Vapor Pressure (mm Hg):	<1mm/70 F	% Volatile by Volume:	0
Vapor Density (Air=1):	5.8	Evaporation Rate:	NA
Solubility in Water:	slight		
Appearance and Odor:	light yellow, no odor.		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point (method used): 396 F. Flammable Limits: NA

Extinguishing Media: Water, CO2, Foam

Special Fire Fighting Procedures: If product is exposed to fire or intense heat, toxic fumes may be generated. If exposure is likely, complete body protection may be required.

Unusual Fire and Explosion Hazards: None except fumes noted above. Will burn if ignited.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value: NA

Effects of Overexposure: May cause irritation to skin and eyes and dust may cause damage to lung tissue.

Emergency and First Aid Procedures: In case of contact with eyes, immediately flush eyes with plenty of water for at least 15 minutes; obtain medical attention. For Skin: wash exposed areas of body thoroughly with soap and water. Obtain medical treatment.

SECTION VI - REACTIVITY DATA

Stability: Stable

Incompatibility: Strong reducing agents, cyanides

Hazardous Decomposition Products: Oxides of nitrogen

Hazardous Polymerization: Will not Occur

SECTION VII - SPILL OR LEAK PROCEDURES

Steps To Be Taken in Case Material is Released or Spilled:

Sweep up spillage and place in covered drum for disposal. Flush spill area with water. Do not drain into sewers.

Waste Disposal Method:

Material may be incinerated or put in a hazardous chemical landfill.

For Waste Treatment of Operating Solution:

Consult Enthone Operating Instructions

SECTION VIII - SPECIAL PROTECTION INFORMATION

Respiration Protection:

If dust is present use suitable dust respirator.

Ventilation:

Local Exhaust: Yes

Protective Gloves: Yes, rubber

Eye Protection: Yes, chemical safety glasses

Other Protective Equipment:

Not ordinarily required.

SECTION IX - SPECIAL PRECAUTIONS

Precautions To Be Taken In Handling and Storing:

Use normal care to prevent body contact when handling material. Keep in well ventilated room, away from heat, and flame.

Other Precautions:

Keep in dry, tightly closed container.

CLEPO 204
For Stripping Nickel Without the Use of Cyanide

CLEPO 204 consists of two materials - CLEPO 204-B, a yellow powder, and CLEPO 204-N, a clear liquid. When made up and used as directed, the resulting solution will effectively strip nickel from copper, brass and steel without the use of cyanides. It has also proven effective on electroless nickel which has not been aged or heat treated.

The stripping solution is prepared using the following proportions for 100 gallons (380 litres).

1) Dissolve 33 gal. (125 lit.) CLEPO 204-N in 67 gal. (255 lit.) water.

2) Add 50 lbs. (23 kilograms) CLEPO 204-B and stir until completely dissolved.

Use CLEPO 204 solutions at 140 F - 180 F (60 - 80 C) in mild steel tanks. Stripping rate will vary, depending upon the type of nickel and its thickness.

As CLEPO 204 solutions are used and the concentration of nickel salts builds up, the stripping rate will decrease. The solution may be reactivated by the addition of 2 oz./gal. (15 g/lit.) of CLEPO 204-B. When the total concentration of CLEPO 204-B has reached 12 oz./gal. (90 g/lit.) and the stripping rate has slowed, the solution should be dumped and a new one prepared.

A certain amount of non-adherent smut will appear on the surface of the work. This will often disappear upon longer immersion in the stripping solution or will be easily removed in a subsequent rinse or cleaning cycle. A cyanide dip should not be necessary for smut removal if the work is given the proper immersion time in the CLEPO 204 solution to insure complete stripping.

Certain types of high sulfur bright nickel will produce a heavier smut than others. Running the bath within the recommended temperature range is very important, since low temperatures may result in the formation of smuts which are difficult to remove without a cyanide dip.

When stripping nickel from brass, the work should be removed from the stripping solution as soon as stripping is complete. With extended immersion times, even the inhibiting action of CLEPO 204 cannot always prevent some etching of the base metal. Always run CLEPO 204 solutions at the recommended concentrations and temperatures to insure minimum immersion times. Do not use severely depleted CLEPO 204 solutions for stripping brass since the longer stripping time required may result in some etching of the areas which strip first.

CAUTION.......

CLEPO 204-N liquid is a moderately alkaline liquid and should be kept from contacting skin or eyes. Avoid inhalation of the fumes. In the event of contact with the skin, flush thoroughly with water. For eyes, flush thoroughly with water and get medical attention. Follow same precautions for use solutions.

WASTE DISPOSAL INFORMATION......

CLEPO 204 solutions may be discarded by neutralizing the alkaline content in accordance with locally acceptable standards for effluent pH. Removal of metal sludge may be necessary due to local restrictions. CLEPO 204-B and CLEPO 204-N contain no chromates, cyanides, fluorides, phosphates, silicates or phenolic compounds.

CLEPO 204-N

SECTION I - IDENTIFICATION DATA

DOT Hazard Class	Corrosive Liquid N.O.S.
Chemical Family	Alkyl amine
Chemical Name	CLEPO 204-N
Formula	Mixture

SECTION 2 - PHYSICAL DATA

Boiling Point (F)	Approximately 212 F
Vapor Pressure (mm Hg)	NA
Vapor Density (air=1)	NA
Solubility in Water	Complete
Specific Gravity (H20=1)	.983
Volatile by Volume	99%
Evaporation Rate (H20=1)	1

Appearance and Odor: Brownish liquid

SECTION 3 - FIRE AND EXPLOSION DATA

Flash Point:

None

Extinguishing Media:

This product is not combustible.

Special Fire Fighting Procedures:

Protective clothing and self-contained breathing apparatus should be worn by firefighters in areas where product is stored. Water spray, foam, dry chemical, or carbon dioxide may be used in areas where product is stored.

Unusual Fire and Explosion Hazards:

Will react with some metals, i.e. aluminum, tin and zinc, to release flammable hydrogen gas.

NFPA Hazard Classification: Degree of Hazard

Health	(Blue) - 3	4=Extreme
Flammability	(Red) - 0	3=High
Reactivity	(Yellow)- 1	2=Moderate
		1=Slight
		0=Insignificant

SECTION 4 - REACTIVITY DATA

Stability: Stable

Conditions to Avoid: NA

Incompatibility:

Strong Acids.

Hazardous Decomposition Products:

None

Hazardous Polymerization: Will not occur.

Conditions to Avoid: NA

SECTION 5 - HAZARDOUS COMPONENTS

Paints, Preservatives, and Solvents:

NA

Alloys and Metallic Coatings:

NA

Hazardous Components	Cas No.	TLV	PEL	LD50	% W/W
#1,3-Diethylthiourea	105-55-5	NF	NF	316	0.50
Ethylenediamine	107-15-3	10	25	1160	33.0

TLV=Mg/M3 - PEL=Mg/M3 - LD50=oral, rat, Mg/Kg - NF=None

- The indicated material, if any, is listed as a carcinogen or potential carcinogen by one or more of the following: National Toxicology Program, I.A.R.C. Monographs, OSHA.

** - The indicated material, if any, does not have an established TLV, but does appear on one or more of the following states hazardous substance lists: Connecticut, Illinois, Michigan, Maine, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, Oregon, Rhode Island, West Virginia, and Wisconsin, and is present in this product in amounts greater than 1%.

SECTION 6 - SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill & Leak Procedures:

Liquids should be contained and absorbed with a suitable absorbent, or flushed to the waste treatment area. Flush area with plenty of water. Avoid all personal contact.

Waste Disposal Methods:

Waste solution should not be discharged into sewers or streams. Solution should first be neutralized to a locally acceptable pH, and then well diluted with water. Depending on usage and locality, may also require precipitation and filtration of heavy metals. Otherwise, contact local waste disposal contractor.

SECTION 7 - HEALTH HAZARD DATA

Routes of Exposure

Inhalation:

Airborne concentrations of dust, mist, or spray of this product may cause damage to the upper respiratory tract and even to the lung tissue which could produce chemical pneumonia depending upon severity of exposure.

Skin Contact:

This product is corrosive tissues contacted and may cause burns.

Skin Absorption:

See SKIN CONTACT above.

Eye Contact:

This product is destructive to eye tissues on contact. May cause permanent eye damage.

Ingestion:

This product, if swallowed, will be corrosive to the mouth, throat, and stomach.

Effects of Overexposure

Acute:

Corrosive to all body tissues with which it come in contact.

Chronic:

The chronic local effect may consist of multiple areas of superficial destruction of the skin or of primary irritant dermatitis. Similarly, inhalation of dust, spray, or mist may result in vary degrees of irritation or damage to the respiratory tract tissues.

Emergency and First Aid Procedures

Eyes:

IMMEDIATELY flush eyes with large amounts of water for at least 15 minutes, holding lids apart to ensure flushing of the entire surface. Washing eyes within 1 minute is essential to achieve maximum effectiveness. Seek medical attention immediately.

Skin:

IMMEDIATELY wash contaminated areas with plenty of water for 15 minutes. Remove contaminated clothing and footwear, and wash clothing before reuse. Discard any clothing that can not be decontaminated. Seek medical attention immediately.

Inhalation:

Get person out of contaminated area to fresh air. If breathing has stopped, resuscitate and administer oxygen if readily available. Seek medical attention immediately.

Ingestion:

NEVER give anything by mouth to an unconscious person. If swallowed, DO NOT INDUCE VOMITING. If vomiting occurs spontaneously, keep airway clear. Seek medical attention immediately.

SECTION 8 - SPECIAL HANDLING PROCEDURES

Respiratory:

Respiration protection is not required under normal use. Use NIOSH/MHSA approved respirator where dust, mist, or spray may be generated above the TLV limit.

Ventilation:

Use adequate local exhaust ventilation where dust, mist, or spray may be generated, to maintain level below the TLV limit.

Gloves:

Impervious gloves should be worn (ex. rubber or neoprene).

Eyes:

Chemical safety goggles and/or face shield.

Other:

Chemically resistant shoes and apron. Safety showers and eyewash facilities should be assessable. All contaminated clothing should be washed with soap and water, and dried before reuse.

SECTION 9 - SPECIAL PRECAUTIONS

Handling and Storage Precautions:

Do not store with strong acids or oxidizers. Avoid contact with skin and eyes. Drum must not be used for any other purpose.

Other Precautions:

Keep container tightly closed when not in use. Wash thoroughly after handling. Containers, even those that have been emptied, will retain product residue and vapors. Always obey hazard warnings and handle empty containers as if they were full. Containers must not be used for any other purpose.

CLEPO 204-T

SECTION 1 - IDENTIFICATION DATA

D. O. T. Hazard Class	Chemical NOS
Chemical Family	Aromatic Nitro
Chemical Name	CLEPO 204-T
Formula	Mixture

SECTION 2 - PHYSICAL DATA

Boiling Point (F)	NA
Vapor Pressure (mm Hg)	NA
Vapor Density (air=1)	NA
Solubility in Water	Insoluble
Specific Gravity (H20=1)	NA
Volatile by Volume	NA
Evaporation Rate (H20=1)	NA
Appearance and Odor	Off-white crystalline powder

SECTION 3 - FIRE AND EXPLOSION DATA

Flash Point:

None

Extinguishing Media:

Water, fog, CO2, dry chemical, foam.

Special Fire Fighting Procedures:

Protective clothing and self-contained breathing apparatus should be worn by firefighters in areas where product is stored.

Unusual Fire and Explosion Hazards:

Thermal decomposition will result in the release of potentially dangerous NOX vapors.

NFPA Hazard Classification:		Degree of Hazard
Health	(Blue) - 3	4=Extreme
Flammability	(Red) - 1	3=High
Reactivity	(Yellow)- 1	2=Moderate
		1=Slight
		0=Insignificant

SECTION 4 - REACTIVITY DATA

Stability: Stable

Conditions to Avoid: Avoid open flames or other high temperature sources which might cause thermal decomposition.

Incompatibility:

Base. Grinding or mixing the material in the presence of dry alkali (i.e. sodium or potassium hydroxide) may cause autoignition.

Hazardous Decomposition Products:

Thermal decomposition will result in a release of NOX2 vapors.

Hazardous Polymerization: Will not occur.

Conditions to Avoid: NA

SECTION 5 - HAZARDOUS COMPONENTS

Paints, Preservatives, and Solvents:

NA

Alloys and Metallic Coatings:

NA

Hazardous Components	Cas No.	TLV	PEL	LD50	% W/W
-N O N E-					

TLV=Mg/M3 - PEL=Mg/M3 - LD50=oral,rat,Mg/M3 - NF=None

- The indicated material, if any, is listed as a carcinogen or potential carcinogens by one or more of the following: National Toxicology Program, I.A.R.C. Monographs, OSHA.

** - The indicated material, if any, does not have an established TLV, but does appear on one or more of the following states hazardous substance lists: Connecticut, Illinois, Michigan, Maine, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, Oregon, Rhode Island, West Virginia, and Wisconsin, and is present in this product in amounts greater than 1%.

SECTION 6 - SPILL, LEAK AND DISPOSAL PROCEDURES

Spill & Leak Procedures:

Spilled material may be shoveled up, and stored in closed containers for possible normal use or proper disposal. Flush area with plenty of water.

Waste Disposal Methods:

Waste should not be discharged directly into sewers or streams. Neutralize to a locally acceptable pH, depending on usage and locality. May also require precipitation and filtration of heavy metals.

SECTION 7 - HEALTH HAZARD DATA

Routes of Exposure

Inhalation:

Coughing, sneezing, or other symptoms of upper respiratory tract irritation may occur. Severe exposure may result in lung tissue damage.

Skin Contact:

Dry product can be a skin irritant.

Skin Absorption:

NA

Eye Contact:

Dry product can cause tissue destruction and permanent eye damage if not treated immediately.

Ingestion:

Dry product irritates mucous membranes of the mouth, throat, esophagus, and stomach.

Effects of Overexposure

Acute:

Irritates the mucous membranes of the respiratory tract, mouth, throat, esophagus and stomach. Can also cause permanent eye injury.

Chronic:

Data not available.

Emergency and First Aid Procedures

Eyes:

IMMEDIATELY flush eyes with large amounts of water for at least 15 minutes holding lids apart to ensure flushing of the entire surface. Washing eyes within one minute is essential to achieve maximum effectiveness. Seek medical attention immediately.

Skin:

Wash with plenty of water for 15 minutes. Remove contaminated clothing and footwear, and wash clothing before reuse. Discard any piece of clothing or footwear that can not be decontaminated. Seek medical attention if symptoms are present.

Inhalation:

Get person out of contaminated area to fresh air.

Ingestion:

NEVER give anything by mouth to an unconscious person. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. If vomiting occurs spontaneously, keep airway clear. Seek medical attention immediately.

SECTION 8 - SPECIAL HANDLING PROCEDURES

Respiratory:

Respiration protection is not required under normal use. Use NIOSH/MSHA approved respirator where dust, mist, or spray may be generated.

Ventilation:

Use adequate local exhaust ventilation where dust, mist, or spray may be generated.

Gloves:

Impervious gloves should be worn (ex. rubber or neoprene).

Eyes:

Chemical safety goggles and/or face shield.

Other:

Chemically resistant shoes and apron. Safety showers and eyewash facilities should be accessible. Wash contaminated clothing with soap and water, and dry before reuse.

SECTION 9 - SPECIAL PRECAUTIONS

Handling and Storage Precautions:

Avoid contact with skin and eyes. Wash thoroughly after handling. Store in a cool, dry area in a closed container.

Other Precautions:

Keep container tightly closed when not in use. Wash thoroughly after handling. Containers, even those that have been emptied, will retain product residue and vapors. Always obey hazard warnings and handle empty containers as if they were full. Containers must not be used for any other purpose.

CLEPO ELECTROSTRIP B/C
ELECTROLYTIC NICKEL STRIPPER

CLEPO Electrostrip is a two component system, mildly alkaline electrolytic stripper, designed to safely strip nickel, copper, chromium, zinc, cadmium and other metals from steel. The solution is non-fuming and requires no special ventilation. The bath can be used indefinitely provided concentration and pH are properly maintained, and sludge periodically filtered out. The sludge generated consists of hydroxides of the metal stripped, and is free of cyanides, and phenols. Chromium will be present in the trivalent state if chrome plated parts are processed through the stripper.

OPERATION

* Concentration	2 to 2.5 lbs/gal CLEPO Electrostrip C 5% by volume CLEPO Electrostrip B
Current Density	80 - 150 amps/sq.ft.
Voltage	7-10 volts
Temperature	Room temperature
pH	6.7-8.0 optimum
Tanks	Steel, PVC lined or stainless steel
Racks	Plastisol coated or plain steel. DO NOT use stainless steel, high carbon or hardened steel tips.
Cathodes	Steel & stainless steel. Steel tank walls may be used as the cathode.
Anode/Cathode area	1:2 minimum

*Note: Add salts to warm water to dissolve.

The optimum current density for stripping is obtained by gradually increasing the voltage until gassing starts on the work to be stripped. The setting will vary according to the total surface areas processed and the configuration of the parts.

Current densities far in excess of the optimum value may cause some etching of the exposed steel base metal, welds and racks.

SOLUTION CONTROL

1. Solution pH

   Maintain pH between 6.7-8.0. Add dilute nitric acid to lower pH. If pH falls below 6, contact lab for corrective measure.

2. Concentration of CLEPO Electrostrip B

CLEPO Electrostrip B, the buffer component, is lost by dragout. Additions are made proportionally to amount of Electrostrip C added. Usually 1-2% by volume additions are sufficient to maintain optimum levels of buffer.

3. Concentration of CLEPO Electrostrip C

Take 500 ml sample and allow solution to settle. Add dilute sodium hydroxide (5 ml) to raise pH and speed settling. Filter the solution, and check its specific gravity with a hydrometer, or by accurately weighing a known volume. Use the chart below to estimate the solution concentration.

CONCENTRATION OF CLEPO ELECTROSTRIP C

LB./GAL	SP. GR.	oBE
3.0	1.171	21.2
2.5	1.142	17.9
2.0	1.113	14.7
1.5	1.085	11.2
1.0	1.056	7.7

CLEPO Electrostrip C & B contain no fluorides, chromates, phosphates or phenolics. CLEPO Electrostrip C is an oxidizing agent, it needs to be stored away from open flame, combustible materials, acids or strong reducing agents.

The information presented herein was prepared by technically knowledgeable personnel and to the best of our knowledge is true and accurate. It is not intended to be all-inclusive, and the manner and conditions of use and handling may involve other or additional considerations.

CLEPO ELECTROSTRIP B

SECTION 2 - PHYSICAL DATA

Boiling Point (F)	- >212 F
Vapor Pressure (mm Hg)	- NA
Vapor Density (air=1)	- NA
Solubility in Water	- Complete
Specific Gravity (H2O=1)	- 1.09
Volatile by Volume	- NA
Evaporation Rate (H2O=1)	- >1

Appearance and Odor: Clear Tan/Brown Liquid

SECTION 3 - FIRE AND EXPLOSION DATA

Flash Point - None

Extinguishing Media:
None

Special Fire Fighting Procedures:
NA

Unusual Fire and Explosion Hazards:
None

NFPA Hazard Classification:

			Degree of Hazard
Health	(Blue)	- 1	4=Extreme
Flammability	(Red)	- 0	3=High
Reactivity	(Yellow)	- 1	2=Moderate
			1=Slight
			0=Insignificant

SECTION 4 - REACTIVITY DATA

Stability: Stable
Conditions to Avoid: NA

Incompatibility:
Strong Acids

Hazardous Decomposition Products:
None Expected

Hazardous Polymerization: Will not occur
Conditions to Avoid: NA

SECTION 5 - HAZARDOUS COMPONENTS

Paints, Preservatives, and Solvents:
NA

Alloys and Metallic Coatings:
NA

Hazardous Components	Cas No.	TLV	PEL	LD50	%W/W
Boric Acid	10043-35-3	10	NF	2660	33.3
Mono Ethanol Amine (Ethanolamine)	141-43-5	3	NF	2100	33.0

TLV = Mg/M3 - PEL - Mg/M3 - LD50 = Oral, rat, Mg/Kg - NF = None

- The indicated material, if any, is listed as a carcinogen or potential carcinogen by one or more of the following: National Toxicology Program, I.A.R.C. Monographs, OSHA.

** - The indicated material, if any, does not have an established TLV, but does appear on one or more of the following states hazardous substance lists: Connecticut, Illinois, Michigan, Maine, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, Oregon, Rhode Island, West Virginia, and Wisconsin, and is present in this product in amounts greater than 1%.

SECTION 6 - SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill and Leak Procedures:

Liquids should be contained and adsorbed with a suitable adsorbent, or flushed to the waste treatment area. Flush area with plenty of water. Avoid all personal contact.

Waste Disposal Methods:

Waste solution should not be discharged into sewers or streams. Solution should first be neutralized to a locally acceptable pH, and then well diluted with water. Depending on usage and locality, may also require precipitation and filtration of heavy metals. Otherwise, contact local waste disposal contractor.

SECTION 7 - HEALTH HAZARD DATA

ROUTES OF EXPOSURE

Inhalation:

Inhaling mist or spray is irritating to the upper respiratory tract and depending on the severity of exposure, may cause tissue damage.

Skin Contact:

This product is irritating to tissues contacted and may cause skin damage.

Skin Absorption:

See SKIN CONTACT above.

Eye Contact:

This product is irritating to eye tissues on contact. May cause permanent eye damage.

Ingestion:

This product, if swallowed, will be irritating to the mouth, throat, and stomach.

EFFECTS OF OVEREXPOSURE

Acute:

Irritating to all body tissues with which it comes in contact.

Chronic:

Repeated or prolonged exposure may cause dermatitis.

EMERGENCY AND FIRST AID PROCEDURES

Eyes:

IMMEDIATELY flush eyes with large amounts of water for at least 15 minutes, holding lids apart to ensure flushing of the entire surface. Washing eyes within 1 minute is essential to achieve maximum effectiveness. Seek medical attention immediately.

Skin:

Immediately wash contaminated areas with plenty of water for 15 minutes. Remove contaminated clothing and footwear, and wash clothing before reuse. Discard any clothing that can not be decontaminated. Seek medical attention immediately.

Inhalation:

Get person out of contaminated area to fresh air. If breathing has stopped, resuscitate and administer oxygen if readily available. Seek medical attention immediately.

Ingestion:

NEVER give anything by mouth to an unconscious person. If swallowed, DO NOT induce vomiting. Give large quantities of water. If vomiting occurs spontaneously, keep airway clear. Seek medical attention immediately.

SECTION 8 - SPECIAL HANDLING PROCEDURES

Respiratory:

Respiration protection is not required under normal use. Use NIOSH/MSHA approved respirator where mist or spray may be generated above the TLV limit.

Ventilation:

Use adequate local exhaust ventilation where mist or spray may be generated, to maintain level below the TLV limit.

Gloves:
Impervious gloves should be worn (ex. rubber or neoprene).

Eyes:

Chemical safety goggles and/or face shield.

Other:

Chemically resistant shoes and apron. Safety showers and eyewash facilities should be accessible. All contaminated clothing should be washed with soap and water, and dried before reuse.

SECTION 9 - SPECIAL PRECAUTIONS

Handling and Storage Precautions:

Avoid contact with skin and eyes. Wash thoroughly after handling material. Store in a cool, dry area, in a closed container when not being used.

Other Precautions:

Keep container tightly closed when not in use. Wash thoroughly after handling. Containers, even those that have been emptied, will retain product residue and vapors. Always obey hazard warnings and handle empty containers as if they were full. Containers must not be used for any other purpose.

CLEPO ELETROSTRIP C

SECTION 2 - PHYSICAL DATA

Boiling Point (F)	- NA
Vapor Pressure (mm Hg)	- NA
Vapor Density (air=1)	- NA
Solubility in Water	- Complete to 5 lbs./gal.
Specific Gravity (H20=1)	- NA
Volatile by Volume	- NA
Evaporation Rate (H20=1	- NA

Appearance and Odor: White, Free Flowing Granuals

SECTION 3 - FIRE AND EXPLOSION DATA

Flash Point - None

Extinguishing Media:
CO2, Water, Dry Chemical, Foam

Special Fire Fighting Procedures:
NA

Unusual Fire and Explosion Hazards:
None

NFPA Hazard Classification:

			Degree of Hazard
Health	(Blue)	- 1	4=Extreme
Flammability	(Red)	- 0	3=High
Reactivity	(Yellow)	- 1	2=Moderate
			1=Slight
			0=Insignificant

SECTION 4 - REACTIVITY DATA

Stability: Stable
Conditions to Avoid: NA

Incompatibility:
Reducing Agents

Hazardous Decomposition Products:
None Expected

Hazardous Polymerization: Will not occur.
Conditions to Avoid: NA

SECTION 5 - HAZARDOUS COMPONENTS

Paints, Preservatives, and Solvents:
NA

Alloys and Metallic Coatings:
NA

Hazardous Components	Cas No.	TLV	PEL	LD50	% W/W
- N O N E-					

TLV =Mg/M3 - PEL = Mg/M3 - LD50 = oral, rat, Mg/Kg - NF - None

- the indicated material, if any, is listed as a carcinogen or potential carcinogen by one or more of the following: National Toxicology Program, I.A.R.C. Monographs, OSHA.

** - The indicated material, if any, does not have an established TLV, but does appear on one or more of the following states hazardous substance lists: Connecticut, Illinois, Michigan, Maine, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, Oregon, Rhode Island, West Virginia, and Wisconsin, and is present in this product in amounts greater than 1%.

SECTION 6 - SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill & Leak Procedures:

Spilled material may be shoveled up, and stored in closed containers for possible normal use or proper disposal. Flush area with plenty of water.

Waste Disposal Methods:

Waste should not be discharged directly into sewers or streams. Neutralize to a locally acceptable pH, depending on usage and locality. May also require precipitation and filtration of heavy metals.

SECTION 7 - HEALTH HAZARD DATA

ROUTES OF EXPOSURE

Inhalation:

Coughing, sneezing, or other symptoms of upper respiratory tract irritation may occur. Severe exposure may result in lung tissue damage.

Skin Contact:

Dry product can be a skin irritant.

Skin Absorption:

NA

Eye Contact:

Dry product can cause tissue destruction and permanent eye damage if not treated immediately.

Ingestion:

Dry product irritates mucous membranes of the mouth, throat, esophagus, and stomach.

EFFECTS OF OVEREXPOSURE

Acute:

Irritates the mucous membranes of the respiratory tract, mouth, throat, esophagus, and stomach. Can also cause permanent eye injury.

Chronic:

Data not available.

EMERGENCY AND FIRST AID PROCEDURES

Eyes:

IMMEDIATELY flush eyes with large amounts of water for at least 15 minutes holding lids apart to ensure flushing of the entire surface. Washing eyes within one minute is essential to achieve maximum effectiveness. See medical attention immediately.

Skin:

Wash with plenty of water for 15 minutes. Remove contaminated clothing and footwear, and wash clothing before reuse. Discard any piece of clothing or footwear that can not be decontaminated. Seek medical attention if symptoms are present.

Inhalation:

Get person out of contaminated area to fresh air.

Ingestion:

NEVER give anything by mouth to an unconscious person. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. If vomiting occurs spontaneously, keep airway clear. Seek medical attention immediately.

SECTION 8 - SPECIAL HANDLING PROCEDURES

Respiratory:

Respiration protection is not required under normal use. Use NIOSH/MSHA approved respirator where dust, mist, or spray may be generated.

Ventilation:

Use adequate local exhaust ventilation where dust, mist, or spray may be generated.

Gloves:

Impervious gloves should be worn (ex. rubber or neoprene).

Eyes:

Chemical safety goggles and/or face shield.

Other:

Chemically resistant shoes and apron. Safety showers and eyewash facilities should be accessible. Wash contaminated clothing with soap and water, and dry before reuse.

SECTION 9 - SPECIAL PRECAUTIONS

Handling and Storage Precautions:

Avoid contact with skin and eyes. Wash thoroughly after handling. Store in a cool, dry area in a closed container.

Other Precautions:

Keep container tightly closed when not in use. Wash thoroughly after handling. Containers, even those that have been emptied, will retain product residue and vapors. Always obey hazard warnings and handle empty containers as if they were full. Containers must not be used for any other purpose.

NICKEL STRIPPER ST

This product is for the electrolytic removal of copper, brass, nickel, cadmium and tin deposits from steel.

OPERATING CONDITIONS:

Temperature:	105 - 150 F (40 - 65 C)
Voltage:	over 7 V. (if voltage falls below this value, remove sludge and replenish the bath correspondingly.) Parts to be stripped must be made anodic, with positive rack contact.

EQUIPMENT:

Tank:	Steel with rubber or plastic lining.
Heating:	Immersion heaters made of glass or ceramic. Make sure that there is a space of at least 12 inches between the bottom of the heaters and the bottom of the tank.
Cathodes:	Mild steel plates.

MAKE UP PROCEDURE per 100 gallons:

CAUTION: Nickel Stripper ST is an oxidizing agent.

When handling chemicals, wear protective clothing and goggles. Avoid skin and eye contact, don't inhale dust. Flush exposed areas immediately with clean, cold water. In case of injury contact a physician at once.

1) Fill tank with 50 gal of water (105 -140 F)

2) Dilute 210 lbs (95 kg) of Nickel Stripper ST with stirring and fill up to final volume. The specific gravity should be 1.166.

MAINTENANCE:

We recommend siphoning off the supernatant, clear solution from time to time, removing the sludge. After removing the sludge, return the supernatant to the tank, add water to restore the volume, and add ST salts to restore the specific gravity to 1.166.

Maintain the pH at 8-10 with additions of acetic acid or caustic soda solution.

METEX METAL STRIPPER SS NO. 2

Metex Metal Stripper SS No. 2 is a liquid acid material. It is an immersion strip requiring no current. Using this product, all commercially electroplated coatings, except heavy chromium* and most precious metals, can be stripped from stainless steel or aluminum.

*In actual practice, decorative chrome plate is usually removed because the underlying deposits of nickel, copper, or other plate are dissolved, undercutting the chromium which flakes off.

EXCELLENT RACK STRIP

Metex Metal Stripper SS No. 2 is excellent for stripping stainless steel rack contacts. The mechanical removal of plate build-up from rack contacts is a costly operation. It must be done by individual hand hammering. Racks and coatings are usually damaged. This results in poor contact, non-uniform plate thickness, plate shading, and coatings which drag out excessive amount of solution from one bath to the other. The practice of hammering also shortens rack life. Solution carryover increases plating rejects and creates necessity for treating plating solutions which is expensive and time consuming. When chrome is in the cycle, contamination is considerably increased with damaged coatings.

Using Metex Metal Stripper SS No. 2 as a regular step in the process cycle eliminates the unnecessary expense of mechanical rack stripping and the related rack maintenance.

STRIPS ELECTROLESS NICKEL

Metex Metal Stripper SS No. 2 does an excellent job of stripping electroless nickel from glass lined or stainless steel tanks.

BENEFITS FROM USING METEX METAL STRIPPER SS NO. 2

Feature	Benefit
1. Prepared solution used full strength	- Labor costs reduced - easier handling.
2. Minimum control required	- Labor costs reduced - simple operation
3. Rapid stripping	- Less time - lower costs-shorter time in automatic equipment means lower capital investment. Fewer racks required.
4. Long life and reduced labor cost.	- Inexpensive to use.

5. Strips plated coatings except heavy chrome from stainless steel rack contacts. - Racks and coatings not damaged, reduces rack repair and replacement costs.

6. Solution contamination reduced because of clean tips and undamaged coating. - Work is better, costly shutdowns because of contamination are eliminated.

7. True contacts, no shading of plate deposits. - Better quality work - less wasted plating metal.

8. Uniform plate thickness. - Better quality and corrosion resistance.

9. Excellent solution stability. - Long life - lower operating cost - less frequent dumping.

NOTE: The question of relative conductivity of phosphor bronze and stainless steel is frequently raised. Based on measurements made in air, the conductivity of stainless steel is less than that of phosphor bronze. However, the conductivity when immersed in plating solution increases several fold. There is generally no current carrying problem with rack tips. Because of the mechanical requirement of holding parts, most phosphor bronze rack tips must be made considerably heavier than required for electrical purposes. Thus, if the stainless steel contacts are made the same size as the phosphor bronze, ample electrical capacity will be available. In actual conversions to stainless steel contacts from phosphor bronze, there have been no problems as long as this practice has been followed.

EASY TO USE - ECONOMICAL

Metex Metal Stripper SS No. 2 is a prepared solution used full strength at room temperature and requires little control. No electric current is required. Stripping is fast. At room temperature, 80-90 F. (27-32 C.), the rate is approximately .0005 to .0020" (13 to 51 microns) of nickel per minute. After considerable usage, stripping rate will be come slower, but can be increased again by heating to 120 F. (49 C) or by adding fresh Metex Metal Stripper SS No. 2.

The solution has long life. As a guide to its length of life, one gallon (3.781.) of fresh solution will strip 36.5 sq. ft. (340 sq. dm.) of nickel .001" (25.4 microns) thick.

Though this material acts readily to remove the plated coatings, there is no etch of stainless steel or aluminum.

OPERATING INSTRUCTIONS

Concentration - Use full strength as received. No dilution permissible. Avoid reclaim rinses and excessive drag-in.

Temperature - 75-100 F (25-40 C). After 15 to 20 oz./gal (115 to 150 gm./l.) of nickel have been dissolved, can be raised to 120 F (50 C).

Tanks - Stainless Steel Type 316 (alternates - Types 321 or 347), ceramic crock, PVC. The tank may be lined with non-plasticized PVC.

NOTE: Plain carbon steel tanks with lining should not be used because Metex Metal Stripper SS No. 2 is strongly acidic, and if a break in the lining should occur, the stripper will vigorously attack the steel generating strong acid fumes.

Heating and Cooling Coils - Stainless Steel Type 316 or alternates, quartz, tantalum, Karbate, Teflon super coils or titanium.

Rack Tips - Stainless Steel Type 302, spring tempered (alternate - Stainless Steel Type 430 spring tempered), or titanium. It is recommended that tips be sandblasted before coating is applied in order to promote better adhesion of the coating.

Time - Dependent upon type of plate and thickness - will remove .0005 to .002" (12.7 to 51 microns) of nickel per minute.

NOTE: Gassing ceases when deposit is completely stripped.

Cooling - Should be provided for installation where a large volume of work is stripped in a small volume of solution.

Ventilation* - Required. 100 cfm per square foot of solution surface.

STRIPPING CYCLE

1. Strip chromium in anodic alkaline cleaner, Anodex (Data Sheet No. 0101).

2. Cold water rinse.

3. Drain (do not carry excess water in Metex Metal Stripper SS No. 2).

4. Strip nickel and/or copper in Metex Metal Stripper SS No. 2 as per operating instructions.

5. Cold water rinse.

6. Neutralize, 2 oz./gal. (15 gm/l.) sodium hydroxide or sodium carbonate or in an alkaline cleaner, Anodex.

7. Cold water rinse.

8. Hot water rinse.

9. Dry.

NOTE: For automatic operations, it may be advisable to include a hot air blow-off or an air knife in Step No. 3 above. Excess water carried into Metex Metal Stripper SS No. 2 will reduce stripping speed and capacity, increasing the cost of the stripping operations.

*A tank cover of PVC, fiberglass, stainless steel or aluminum is suggested. Keep the tank covered when the tank is not in use to minimize ventilation requirements.

CONTROL PROCEDURE

Dissolved Metal Analysis in Metex Metal Stripper SS No. 2

Apparatus:

10 ml. pipette
100 ml. volumetric flask
250 ml. Erlenmeyer flask
50 ml. burette

Reagents:

Ammonium Hydroxide, concentrated
Murexide indicator (0.2 grams of Murexide in 100 grams sodium chloride)
0.1M EDTA solution

Procedure:

Pipette a 10 ml sample in the 100 ml. volumetric flask and adjust to volume.

Pipette a 10 ml aliquot of this dilution into a 250 ml. Erlenmeyer flask.

Add 40 ml water, 10 ml. ammonium hydroxide, and 1 gram Murexide indicator.

Titrate with 0.1M EDTA to a violet endpoint.

Calculation:

If all nickel:

ml titration x 0.783=oz.nickel/gal.

(oz./gal. x 7.5=gm./l.)

If all copper:

ml titration x 0.848=oz.copper/gal.

(oz./gal x 7.5=gm./l.)

If a mixture of copper and nickel, use a proportional factor as:

ml titration x 0.81=oz.total metal/gal.

(oz./gal. x 7.5=gm./l.)

As the dissolved metal content approaches 25 oz./gal. (187.5 gm./l.), the solution must be considered exhausted and should be replaced. It is possible to discard only a portion of the solution, about 25%, and replenish with fresh Metex Metal Stripper SS No. 2.

Replace drag-out and evaporation losses with fresh Metex Metal Stripper SS No. 2, not with water.

TROUBLESHOOTING

Low stripping rate	Low temperature. Metex Metal Stripper SS No.2 is inactive below 60 F. (15 C.).	Increase temp to 70 F (20 C) or higher.
	High metal content, solution may be exhausted.	Analyze. Renew or replenish.
	Chrome stripped from nickel?	Strip chrome.
	Dirty or oily work?	Pre-clean.
	Excessive water drag-in.	Drain.
Low capacity (many of the factors causing low rate will also affect the capacity).	Low Temperature.	Increase temp. to 70 F (20 C) or higher.
	High metal content.	Analyze. Renew or replenish.

High loading (a large number of small parts can quickly exhaust a low volume of stripper).	Analyze. Renew or replenish.

WARNING:

Metex Metal Stripper SS No. 2 is a strong oxidizing acidic material. Avoid eye and skin contact. Wear protective clothing and goggles during make-up and operation. Flush exposed areas immediately with cold water. Consult a physician in case of injury. VAPOR EXTREMELY HAZARDOUS. May cause nitrous gas poisoning. Do not inhale fumes. Provide adequate ventilation.

Consult your MacDermid Technical Representative for engineering service on all metal finishing problems.

WASTE DISPOSAL

1. Slowly pump 100 gallons (378 l.) of cooled Metex Metal Stripper SS No. 2 into approximately 400 gallons (1512 l.) of rinse water with mild air agitation. Leave the rinse tank level low - 8 to 10 inches. (Use proper precaution in handling strong acids.)

2. To this diluted solution, and using mild air agitation, slowly add 150 lbs., 0.3 lb/gal. (36 gm./l.) of soda ash. The soda ash should be added a little at a time as it will react with the dilute acids, giving off large volumes of carbon dioxide gas, and if added too fast will cause the tank to overflow.

3. Check the pH of the solution and when it reaches 3.0 or above, no more dry soda ash should be added. At pH above 3.0 the dry soda ash will cake up and will not react with the acids. Therefore, the final neutralization to a pH of 7.0 to 8.0 should be done with the soda ash mixed in water, 2 lbs per gallon (240 gm./l.) and added to the tank.

4. When the solution pH is 7.0 to 8.0, it will be milky and completely neutralized.

   100 gallons (378 l.) of Metex Metal Stripper SS No. 2 will require approximately 200 to 500 lbs. (2 to 5 lb/gal or 240 to 600 gm./l.) of soda ash for neutralization.

STANDARD PACKAGES: 55, 30, 13 and 1 gallon container.

METEX SILVER STRIPPER CB

Metex Silver Stripper CB is an acid solution for stripping silver from copper, brass and other copper alloys. The process operates by immersion. No current is required. Copper, brass and copper alloy basis metals are not etched. A nickel strike under silver plate will also be stripped.

Metex Silver Stripper CB is a single prepared solution ready to use. It has long life and acts rapidly. The rate of stripping is 0.0001" per minute.

In addition to the removal of plated silver from rejected parts, Metex Silver Stripper CB is being used to bright dip silver brazed areas on assemblies.

METHOD OF USE:

Work to be stripped should be free from grease and oil. Soak clean in Metex TS-40A (Data Sheet No. 0501) or electroclean with direct current in Metalex W Special (Data Sheet No. 0311). Immerse clean work in Metex Silver Stripper CB until silver is completely removed.

Concentration:	Full strength
Temperature	120-160 F (50-70 C)
Tank	Glass, ceramic crock, 304 ELC, Polypropylene
Heater	Quartz, Tantalum, Karbate, 304 ELC
Ventilation	Required. A floating layer of Metex Fume Suppressor M-640 (Data Sheet No. 3652) will minimize the ventilation requirement.
Speed	0.0001" per minute at 140 F (60 C)
Capacity	30 sq. ft. of 0.0005" silver per gallon at 140 F (60 C).

CONTROL:

Metex Silver Stripper CB is hydroscopic and will absorb moisture from the atmosphere unless kept covered and warm. This is especially true in humid summer weather. If the specific gravity drops below the normal range of 1.81 to 1.83, evaporate the excess water by heating the solution, uncovered, at 160 F (70 C) until the proper range is restored. Then cover the tank and maintain the temperature at 120 to 140 F (50-60 C) even during down time.

SILVER RECOVERY FROM SPENT METEX SILVER STRIPPER CB

The simplest method of recovering silver from exhausted Metex Silver Stripper CB is by precipitation as silver chloride. Hydrochloric acid is more convenient than sodium chloride if a substantial amount of silver is dissolved in the solution, 8 to 10 Troy oz./gal. or more. A 10% by volume addition of 20 Be hydrochloric acid will precipitate 12 Troy oz./gal.

PROCEDURE:

The solution must be treated in a glass or ceramic container. Stainless steel would be attacked severely.

Dilute the solution with an equal amount of water. CAUTION: The Silver Stripper CB must be added to the water slowly with good agitation and cooling since a large amount of heat will be evolved.

Cool to 70 to 80 F (24 C)

Add 1 gal. of 20 Be hydrochloric acid for each 10 gallons of original Silver Stripper CB with agitation.

Continue agitation for about 1 hour and let settle.

Decant or filter off the silver chloride for reclamation.

Neutralize the remaining solution with caustic soda to a pH near 7 for waste disposal.

STANDARD PACKAGES 5 gal. cans, 1 gal. jugs.

SAFETY AND WARNING INFORMATION

Metex Silver Stripper is a strong acid and should be handled with the same precautions observed for such acidic materials. Avoid skin and eye contact. Flush exposed areas immediately with clean cold water. Wear protective clothing and eye goggles when handling the solution. Contact a doctor immediately in case of injury. OSHA 20 forms are available from Macdermid Inc.

WASTE DISPOSAL

After reclaiming the silver, dilute 10 to 1 with water and then neutralize slowly and with caution (wear goggles and protective clothing) using 25% solution of caustic soda or hydrated lime. Allow to settle in a tank or transfer to settling lagoon. Flush liquid down the sewer. Bury solids in the ground or have hauled away. Observe local regulations on waste disposal.

OMI INTERNATIONAL CORPORATION
21441 Hoover Road
Warren, MI 48089

REVISION: 4/18/86 Phone: 313-497-9129

Product Trade Name: UDYLITE: UDYSTRIP 6000 Make Up
Proprietary Formulation

Hazardous Components Section II

	CAS No.	Percentage	ACGIH
Ammonium Nitrate	6484-52-2	35 to 45	NA

Physical Data Section III

Appearance and Odor: Light yellow liquid with slight ammonia odor.

Solubility in Water:			
Negligible	<0.1%	Boiling Point	NA
Slight	0.1-1.0%	Vapor Pressure	NA
Moderate	1.0-10%	% Volatile by Volume	NA
Appreciable	>10.0%	Evaporation Rate	NA
		Specific Gravity	1.21
Complete (all proportion)	x	pH	5.7

Fire and Explosion Hazard Data Section IV

Flash Point (method used) None Flammable/Explosive Limits LEL N/A UEL N/A
NFPA Code (0-4) Health 0 Flammability 0 Reactivity 1

Extinguishing Media: Product will not burn.
Special Fire-Fighting Procedures: Use media suitable for surrounding fire, but do not attempt to smother fire.
Unusual Fire and Explosion Hazards: If allowed to dry, solid residue may ignite, especially if mixed with organic material.

Health Hazard Data Section V

Threshold Limit Value: None known or established

Effects of Overexposure:
- Acute: Possible eye and skin irritant.
- Chronic: None expected.
- Principal Exposure: Contact

Emergency First Aid Procedures:
- Eye: Flush with a directed stream of water for 15 minutes. Seek medical attention.
- Skin: Wash with soap and water.
- Inhalation: Remove to fresh air.
- Swallowing: Drink water (2-3 glasses) to dilute. Seek medical attention.

Reactivity Date | Section VI

Stability: Stable:x Unstable

Incompatibility
(Materials to Avoid): Organics, combustibles, heat sources.

Hazardous Decomposition
Products: None

Hazardous Polymerization May Occur Will Not Occur x

Spill or Leak Procedures | Section VII

Steps to be taken in case material is released or spilled: Contain and place into a container suitable for transportation to a licensed waste treatment facility.

Waste Disposal Method	Licensed waste treatment facility.		
EPA I.D. Number	N/A	RQ	N/A

Special Protection Information | Section VIII

Ventilation:
Local Exhaust Yes Respiratory Protection No

Protective Clothing:

Gloves	butyl rubber or neoprene	Boots: No
Chem.Goggles	Yes	Other: No
Face Shield	No	

Note: Eye Fountain and Safety Shower must always be available.

Special Precautions | Section IX

Handling & Storage	Store away from organics, combustibles, heat sources.
Other	None

Shipping Information | Section X

DOT Proper Shipping Name		None		
Hazard Class		None		
DOT Label(s)		None		
IATA	Class:	NA	Packing Group:	NA
IMDGC	Class:	NA	Packing Group:	NA

Prepared by: Carl Gilsdorf, Manager, Quality Assurance 4/18/86

This form has been prepared and reviewed by technically knowledgeable people and is based on information OMI International Corporation believes to be reliable. This information is provided solely to provide health and safety guidelines and is not to be intended to any other purpose.

OXYSTRIP 6000

Electrolytic Stripper for Duplex Nickel and Ferronickel Deposits from Ferrous Substrates

The Udylite Oxystrip 6000 process is an electrolytic process designed for the electrostripping of rejected plated products fixtured on plastisol coated racks with stainless steel contacts. The chromium layer must be completely stripped and the nickel deposit activated prior to stripping in Oxystrip 6000.

INITIAL SOLUTION COMPOSITION

	Optimum
Oxystrip 6000 Make-Up	50% by volume

Oxystrip 6000 Make-Up is used primarily for the formulation of the original operating solution. However, it is suggested that a small quantity be retained in inventory for special addition as recommended by your Udylite Technical Service Representative.

OPERATING CONDITIONS

I. Chromium Stripping

A. Chromium deposits must be completely stripped in anodic alkali solution (i.e. OS 486).

B. Rinse thoroughly.

C. Activate in cathodic Oxyvate 345 (16-32 oz/gal) at 6V-9V. Activation time should be at least as long as time taken to strip chromium deposit.

D. Rinse thoroughly.

E. Strip in Oxystrip 6000.

II. Nickel & Other Metal Stripping

	Optimum	Range
pH(Electrometic)	6.0	5.5 to 6.5
Voltage	6 Volts DC for nickel deposits	4 to 9 Volts DC
	3 Volts DC for ferronickel (NIRON) deposits.	3 to 9 Volts DC

Temperature	37.7 C (100 F)	21-43C(70-110F)
Anode Current Density	10 A/dm2(100 A/ft)	1.15 A/dm2
Polarity		Anodic (work is anode)

Cathode to Anode Ratio 4.1 4.1

STRIPPING RATE

	Optimum	Range
Copper	2.3 u/min (0.00009 in/min)	0.5-3.5 u/min (0.00002 in/min - 0.00014 in/min)
Bright Nickel	2.5 u/min (0.00010 in/min)	0.5-3.75 u/min (0.00002 in/min - 0.00015 in/min)
Electroless Nickel	2.0 u/min (0.00008 in/min)	0.4-3.0 u/min (0.00001 in/min - 0.00012 in/min)
Semi Bright Nickel	2.0 u/min (0.00008 in/min	0.4.3.0 u/min (0.00001 in/min - 0.00012 in/min)

NOTE: The rate of stripping is dependent upon current densities applied during the stripping process.

EQUIPMENT

REQUIREMENTS:

Tank	KOROSEAL or other approved lining, deep enough to accommodate twelve inches of sludge formation.
Rectifier	0 to 9 volts, ripple less than 15%.
Cooling Coil	TEFLON or other inert plastic.
Heating	TEFLON or quartz immersion heater.
Ventilation	Recommended (nonmetallic construction).
Cathodes	Type 301, 304 or 316 stainless steel (Perforated cathodes are NOT acceptable).
Racks	Plastisol coated, positive contact, steel or stainless steel tips. DO NOT use copper or copper bearing alloys as contact tips.)

MAKE-UP PROCEDURE

For each 378 liters (100 gallons) of solution:

1. After thorough leaching and rinsing fill the clean process tank one-quarter full with water, 95 liters (25 gallons.)

2. With continuous stirring, carefully add 190 liters (50 gallons) of Oxystrip 6000 Make-Up.

3. Adjust with water to operating level.

4. Mix thoroughly and adjust pH to 6.0 using concentrated nitric acid to lower the pH, or concentrated ammonium hydroxide to raise it.

DANGER! NITRIC ACID IS CORROSIVE AND CAN CAUSE SEVERE BURNS TO BOTH SKIN AND EYES. AVOID BREATHING ANY FUMES BY USING ADEQUATE VENTILATION AND/OR APPROVED RESPIRATORY EQUIPMENT. AVOID CONTACT WITH EYES AND SKIN. WEAR FULL PROTECTIVE CLOTHING, FACE MASK, AND SAFETY GOGGLES. IN CASE OF CONTACT, FLUSH THE EXPOSED AREAS WITH CLEAN, COLD WATER. IN CASE OF INJURY, CONSULT A PHYSICIAN.

DANGER! AMMONIUM HYDROXIDE IS CORROSIVE AND CAN CAUSE SEVERE BURNS TO BOTH SKIN AND EYES. AVOID BREATHING ANY FUMES BY USING ADEQUATE VENTILATION AND/OR APPROVED RESPIRATORY EQUIPMENT. AVOID CONTACT WITH EYES AND SKIN. WEAR FULL PROTECTIVE CLOTHING, FACE MASK, AND SAFETY GOGGLES. IN CASE OF CONTACT, FLUSH THE EXPOSED AREAS WITH CLEAN, COLD WATER. IN CASE OF INJURY, CONSULT A PHYSICIAN.

OXYSTRIP CONTROL PROCEDURES

Oxystrip Replenisher 661

The Oxystrip Replenisher 661 maintains the inhibitor concentration in the bath, and is added at a rate of 3.8 L (1 gal) 1500-3000 AH. Low inhibitor concentration results in etching of basis metal. The optimum inhibitor concentration is 22 g/L (2.9 oz/gal).

Oxystrip Accelerator 662

The Oxystrip Accelerator 662 maintains the index and carrier concentrations in the bath and is added at a rate of 3.9 L(1 gal)/1500-3000 AH. A low index will result in slow stripping, and a high index will increase the stripping rate, but may etch the basis metal. A low carrier concentration will reduce the stripping rate and cause basis metal etch. The optimum Index level is 8.0 units. The optimum carrier concentration is 51 g/L (6.8 oz/gal.).

Oxystrip Controller 663

The Oxystrip Controller 663 maintains the 6000 additive concentration in the bath, and is added at a rate of 1 lb/1500-3000 AH. Too low a concentration will result in slow stripping, and too high a concentration will result in heavy smut formation and slow stripping. The optimum 6000 additive concentration is 2.0 g/L (0.268 oz/gal).

NOTE: ANALYSES FOR THE INHIBITOR, INDEX AND CARRIER ARE INCLUDED AFTER THE WASTE TREATMENT SECTION.

SLUDGE REMOVAL

When sludge accumulates to the level which prevents normal stripping operation, sludge removal will be required. Allow the "precipitated" insoluble material to settle and decant the clean solution into a clean, lined holding tank. Remove the sludge into plastic or rubber lined containers. The sludge will consist of both simple and complex metal salts as well as complex metal cyanides and may have salvage value.

CAUTION: THE SLUDGE FROM OXYSTRIP 6000 IS ACIDIC AND MAY CAUSE BURNS. DO NOT GET IN EYES OR ON SKIN. HAVE ADEQUATE VENTILATION. OPERATORS SHOULD WEAR RUBBER GLOVES, CHEMICAL GOGGLES, AND FACE MASK. IN CASE OF CONTACT WITH SKIN AND/OR EYES, FLUSH THE EXPOSED AREAS WITH CLEAN, COLD WATER. IN CASE OF INJURY, CONSULT A PHYSICIAN.

The solution volume lost due to desludging is to be replaced by additions of Oxystrip 6000 Make-Up.

For every 3.8 liters (1 gal) of sludge removed, add 1890 mL (2 qts) of Oxystrip 5000 Make-Up. Add water to operating level, mix well, and adjust pH to 5.5-6.8 (6.0 optimum), using concentrated nitric acid to lower the pH, or concentrated ammonium hydroxide to raise the pH.

WASTE TREATMENT

Rinses following the stripping operation must be chlorinated to treat ammonium ions, adjusted to a pH of 8.5, following which, disposal of the precipitated metal salts should be accomplished in accordance with applicable regulatory statutes.

In all cases, consult with pertinent waste treatment authorities for specific restrictions in your area.

The sludge of Oxystrip 6000 contains complex metal cyanides.

ANALYTICAL PROCEDURES

DETERMINATION OF OXYSTRIP 6000 ADDITIVE
(Visual Method)

Equipment Required

1 - Volumetric Flask - 1000 mL
5 - Volumetric Flasks - 100 mL
1 - Pipette - 2.0 mL
1 - Pipette - 1.0 mL

Reagent Required

Ferric Reagent - FeCl3.6H20 - 100 grams
Concentrated HCl - 50 mL
Dilute to 500 mL with Deionized Water

Procedure

1. Pipette 2.0 mL of sample to be analyzed into a 100 mL volumetric flask.

2. Pipette 10.0 mL of ferric reagent into the volumetric flask and dilute to volume with deionized water. Mix thoroughly.

3. Prepare a series of color standards by repeating Steps 1 and 2 with solutions containing 1.0, 1.5, 2.0, and 3.0 g/L of Oxystrip 6000 Additive.

4. Visually match the red color of the sample being analyzed (Step 2) to the red color of the standard solutions (Step 3) to obtain the concentration of Oxystrip 6000 Additive in the sample g/L.

5. Optimum 6000 additive concentration: A freshly prepared solution will have a 6000 additive concentration of 2.0 g/L (0.268 oz/gal). To raise the concentration by 1 g/L (0.13 oz/gal), 40d.

DETERMINATION OF OXYSTRIP 6000 ADDITIVE
(Spectrophotometic Method)

Equipment Required

1 - Volumetric Flask - 1000 mL
1 - Volumetric Flask - 100 mL
1 - Pipette - 2.0 mL
1 - Pipette - 10.0 mL
Visible Range Spectrophotometer
with 1.0 cm pyrex cells.

Reagent Required

Ferric Reagent - $FeCl_3 \cdot 6H_2O$ - 100 grams
Concentrated HCl - 50 mL
Dilute to 500 mL with deionized water

Procedure

1. Pipette 2.0 mL of sample to be analyzed into a 100 mL volumetric flask.

2. Pipette 10.0 mL of ferric reagent into the volumetric flask and dilute to volume with deionized water. Mix thoroughly.

3. Measure the absorbence of the above solution at a wavelength of 550 nm using a blank prepared by diluting 100 mL with deionized water.

4. Grams/Liter of Oxystrip 6000 Additive = A550 x 3.48 where A550 = absorbence measured in Step 3.

5. Optimum 6000 additive concentration: A freshly prepared solution will have a 6000 additive concentration of 2.0 g/L (0.268 oz/gal). To raise the concentration by 1 g/L (0.13 oz/gal), 408 g (0.9 lb.) of Oxystrip 663 Controller must be added.

DETERMINATION OF INDEX IN OXYSTRIP 6000 SOLUTION

Equipment Required

2 - Burettes 25 or 50 mL
1 - Erlenmeyer Flask -300 mL
1 - Graduate - 50 mL
1 - Pipette - 5.0 mL

Reagents Required

Silver Nitrate Solution - 0.1N
Potassium Thiocyanate Solution 0.1N
Nitric Acid Concentrated Reagent
Ferric Ammonium Sulfate Indicator - Saturated Solution

Procedure

1. Pipette 5.0 mL of sample to be analyzed into a 300 mL Erlenmeyer flask.

2. Add 75 mL of deionized water, and 10 mL of nitric acid.

3. Add from a burette exactly 10.0 mL of 0.1N silver nitrate solution.

4. Add 5 mL of ferric ammonium sulfate indicator and titrate with 0.1N potassium thiocyanate solution to a reddish brown endpoint.

5. Determine the equivalent value E of the potassium thiocyanate solution by repeating Steps 2 thru 4, omitting step 1.

6. Index = $\frac{E-V}{E} \times N \times 205.8 - [\text{Oxystrip 6000 Additive} \times 1.35]$

Where E = mL of potassium thiocyanate solution used in Step 5

V = mL of potassium thiocyanate solution used in Step 4

N = normality of the silver nitrate solution used in Step 3

7. Optimum Index level is 8.0 units.

8. Gallons of Oxystrip Accelerator 662 required to raise index to 8.0 minus Step 6 x .077 x tank volume. Alternatively, 408 g (0.9 lb) of Oxystrip 400 index for each 378 L (100 gal) of stripping solution will increase the index level by 1.0 unit.

DETERMINATION OF INHIBITOR IN OXYSTRIP 6000 SOLUTION

Equipment Required (Minimum)

1 - Analytical Balance
1 - Trip Balance
1 - Hot Plate
1 - 50 mL Burette
1 - 2 mL Pipette
1 - 50 mL Pipette
1 - 50 mL Graduated Cylinder
1 - 300 mL Erlenmeyer Flask
Boiling Stones or Beads

Reagents Required

0.1 Ceric Sulfate - Place 20.8 g of 100 mesh ceric hydroxide (G. Frederick Smith #17) into a dry 1 liter beaker. Add while stirring, 100 mL of concentrated sulfuric acid. Stir to thoroughly wet all the ceric hydroxide. Add 100 mL of distilled water while stirring. The temperature will rise to 100 C but no appreciable spattering will occur. With continued stirring, add an additional 200 mL of water to dissolve the ceric hydroxide. Dilute to 1 liter with distilled water and standardize as follows:

Weigh accurately 1.5 to 1.8 g of ferrous ethylenediammonium sulfate (G. Frederick Smith #41) and transfer into a 300 mL Erlenmeyer flask. With a graduate, add about 150 mL of distilled water and 10 mL of concentrated sulfuric acid. Swirl to dissolve the salt. Add 2 to 3 drops of ferroin indicator and immediately titrate the solution with the ceric sulfate solution until the color changes from pink to colorless with a faint bluish tinge.

The normality of the ceric sulfate solution equals:

$$N = \frac{WT}{V \times 0.3822}$$

where WT = weight of ferrous ethylenediammonium sulfate taken

where V = volume of ceric sulfate used

0.1N Ferrous Ammonium sulfate - Dissolve 40 g of ferrous ammonium sulfate in about 200 mL of distilled water. Add 20 mL of concentrated sulfuric acid and dilute to 1 liter with distilled water.

Ferroin Indicator - G. Frederick Smith #165

Concentrated Sulfuric Acid - Reagent grade

Procedure

1. With a graduate, add 70 mL of distilled water into a 300 mL Erlenmeyer flask. While swirling the flask, slowly add from a graduate 25 mL of concentrated sulfuric acid.

2. Pipette 2.0 mL of the sample to be analyzed into the Erlenmeyer flask containing the 25% sulfuric acid in Step 1. Add a boiling stone or two.

3. Pipette exactly 50.0 mL of 0.1M ceric sulfate solution into the Erlenmeyer flask and gently boil the solution for 30 minutes.

4. Remove the flask from the hot plate, cool to room temperature, and add 3 to 4 drops of ferroin indicator.

5. Titrate the solution with 0.1N ferrous ammonium sulfate solution until the color changes from orange through colorless to red.

6. Pipette exactly 50.0 mL of the 0.1N ceric sulfate solution into a clean 300 mL Erlenmeyer flask containing 75 mL of distilled water and 25 mL of concentrated sulfuric acid.

Cool to room temperature, add 3 to 4 drops of ferroin indicator and titrate with 0.1N ferrous ammonium sulfate solution until the color changes from orange through colorless to red.

7. Grams/L Inhibitor = $\frac{E-V}{E} \times N \times 375$

   Where E = Volume of 0.1 ferrous ammonium sulfate equivalent to 50.0 mL of 0.1N ceric sulfate solution obtained in Step 6.

   V = Volume of 0.1N ferrous ammonium sulfate solution used in Step 5.

   N = Normality of the ceric sulfate solution.

8. Optimum Inhibitor level is 22.0 g/L.

9. Gallons of Oxystrip Replenisher 661 required to raise inhibitor to 22.0 g/L equals 22.0 minus Step 7 x 0.0186 x tank volume. Alternatively 408 g (0.9 lb) of Oxystrip 400 Inhibitor for each 378 L (100 gal) of stripping solution will increase the inhibitor concentration by 1 g/L (0.13 oz/gal).

DETERMINATION OF CARRIER IN OS-6000

Equipment Required

Boiling Beads or chips
1 - Burette - 50 mL
1 - Erlenmeyer flask - 300 mL
1 - Graduate - 50 mL
1 - Kjeldahl flask - 500 mL
1 - Volumetric pipette - 1.0 mL
1 - Distilling Apparatus such as E. H. Sargent S-63410 or equivalent

Reagents Required

Boric Acid Collecting Solution - Dissolve 20 g of boric acid in 1 liter of distilled water.

Mixed Indicator - Mix 50 mL of 0.2% methyl red in ethanol with 25 mL of 0.2% methylene blue in ethanol.

Sodium Hydroxide Solution 20% - Dissolve 200 g of reagent sodium hydroxide in 1 liter of distilled water.

Standard Hydrochloric Acid Solution - 0.1N.

Procedure

1. Place 50 mL of Boric Acid collecting solution and 10 to 15 drops of mixed indicator in a 300 mL Erlenmeyer flask. Place the flask in the receiving position on the distilling apparatus. (The Kjeldahl delivery tube should extend below the liquid level in the receiving flask).

2. Pipette 1.0 mL of the solution to be analyzed into the Kjeldahl flask.

3. Add several boiling beads to the Kjaldahl flask, 150 mL of distilled water and 20 mL of 20% sodium hydroxide solution. Connect the flask immediately to the distilling apparatus so that the distillate is caught into the Erlenmeyer flask. Swirl gently to mix. Turn on the condenser cooling water and also the distilling flask heater.

4. Continue the distillation until 75 to 100 mL of distillate have distilled into the receiving flask. (Total volume in the receiving flask will be 125 to 150 mL).

5. Remove the receiving flasks from the distillation apparatus and titrate the contents with 0.1N hydrochloric acid from green to reddish violet endpoint.

6. Grams/L Carrier V x N x 17.
   V = mL of 0.1N HCl required to titrate receiving flask.

   N = normality of the 0.1N NCl.

NOTE: USUALLY STEP 4 IS COMPLETE AFTER 75 TO 100 mL OF DISTILLATE HAS BEEN COLLECTED. HOWEVER, TO ENSURE COMPLETE RECOVER, DISTILLATION CAN BE CONTINUED WHILE THE FIRST 75 TO 100 mL IS TITRATED AS INDICATED IN STEP 5.

THE SECOND VOLUME IF DISTILLATE IS NOW ADDED TO THE SOLUTION TITRATED IN STEP 5. IF THE INDICATOR TURNS GREEN AFTER THE ADDITION OF THE SECOND DISTILLATE, THE CARRIER HAS NOT BEEN RECOVERED. IF THE COLOR REMAINS VIOLET, THE DISTILLATION AND RECOVERY OF THE CARRIER IS COMPLETE.

ADJUSTMENT: Optimum Carrier concentration is 51 g/L

Gallons of Oxystrip Accelerator 662 to raise to 51 g/L equals 51 minus Step 6 x 0.0065 x tank volume.

UDYLITE IMMERSION STRIPPER 406

1.0 INTRODUCTION

UDYLITE Immersion Stripper 406 a process designed to strip electroplated, sulfur-free and sulfur containing nickel deposits from copper and copper alloy substrates. This process is highly stable, simple to control and economical to operate. It can be used to strip parts or racks.

2.0 SOLUTION COMPOSITION AND OPERATING CONDITIONS

UDYLITE 408 Immersion Stripper	50 lb/100 gal (60 g/L)
UDYLITE 406 Immersion Stripper	0.8 lb/100 bal (1 g/L)
Sulfuric Acid 66 Be′	5% by volume

2.2 Operating Conditions

	Optimum	Range
Temperature	160 F (71 C)	150 to 200 F (66 to 43 C)
pH	2.0	1.0 to 2.5

3.0 STRIPPING RATE

A new bath begins to strip at the following rates:

At 150 F (65.5 C)	4.4 to 5.3 mils/hr
At 180 F (83 C)	4.4 to 5.3 mils/hr
At 200 F (93 C)	7.0 to 7.5 mils/hr

As the bath is used and soluble nickel concentration begins to build, the stripping rates fall off significantly without any additions of the 408 Immersion Stripper and 406 Immersion Stripper. Upon operating the bath to a dissolved nickel concentration of about 6 oz/gal (45 g/L), the stripping rates are the following:

At 150 F (65.5 C)	.023 to .028 mils/hr
At 180 F (83 C)	.045 to .049 mils/hr
At 200 F (93 C)	.05 to .053 mils/hr

Upon the addition of a full charge of 0.8 lb/100 gal (1 g/L) UDYLITE 406 Immersion Stripper, and a half charge of 25 lb/ 100 gal (30 g/L) UDYLITE 408 Immersion Stripper, the stripping rates increase.

At 150 F (65.5 C)	2.0 to 2.5 mils/hr.
At 180 F (83 C)	2.0 to 2.5 mils/hr.
At 200 F (93 C)	2.8 to 3.5 mils/hr.

The stripping rates remain stable until the dissolved nickel approaches about 8 oz/gal (60 g/L). Further additions of 0.8 lb/100 gal (1 g/L) 406 Immersion Stripper and 25 lb/100 gal (30 g/L) 408 Immersion Stripper again increase the stripping rate but never to the original rates of a new bath. At a dissolved nickel content of about 11 oz/gal (82.5 g/L), the additions of 406 Immersion Stripper and 408 Immersion Stripper will not reset the stripping rate.

It is recommended that the 406 Immersion Stripper and 408 Immersion Stripper be kept in the original ratio concentrations and additions be made with each 1.6 lb/ 100 gal (2 g/L) nickel content increase.

4.0 EQUIPMENT REQUIREMENTS

Tank:	Ceramic ware, rubber lined or lead.
Heating Coils:	Lead or Quartz Immersion.
Baskets used for Stripping:	Rubber or plastic coated metal baskets.
Agitation:	Air or mechanical means.
Tank Ventilation*	Required, 250 cubic feet per minute of exhaust per each square foot of exposed surface area of the tank is recommended.

5.0 PROCESS MATERIALS REQUIRED

UDYLITE 408 Immersion Stripper	Specify OMI Product Code 102641
UDYLITE 406 Immersion Stripper	Specify OMI Product Code 102673
Sulfuric Acid 66 Be'	Specify OMI Product Code 100171

6.0 PROCESS MAKE-UP

For each 100 gallons (378 liters) of solution:

6.1 To a CLEAN tank, add 25 gallons (95 liters) of water.

6.2 With continuous stirring, slowly add 5 gallons (19 liters) of sulfuric acid.

DANGER! SULFURIC ACID IS VERY CORROSIVE. CAUSES SEVERE BURNS TO BOTH EYES AND SKIN. REACTS VIOLENTLY WITH WATER. STRONG OXIDIZER. AVOID BREATHING ANY FUMES BY USING ADEQUATE VENTILATION AND/OR APPROVED RESPIRATORY EQUIPMENT. WEAR FULL PROTECTIVE CLOTHING, FACE MASK AND SAFETY GOGGLES. IN CASE OF CONTACT, FLUSH THE EXPOSED AREAS WITH CLEAN COLD WATER. IN CASE OF INJURY, CONSULT A PHYSICIAN.

6.3 While mixing, add 50 lbs (23 Kg) of UDYLITE 408 Immersion Stripper and 0.8 lb (0.36 Kg) of UDYLITE 406 Immersion Stripper.

6.4 Continue stirring until all solids are dissolved.

6.5 Adjust with water to operating level.

7.0 PROCESS MAINTENANCE AND CONTROL

7.1 Sulfuric acid is consumed in the stripping process. Acid concentrations can be maintained by maintaining the pH at optimum range. Daily pH checks using a pH meter and small frequent additions of sulfuric acid will insure consistent stripping rates. A pH above the recommended range will result in slower stripping rates. Low pH operations is not detrimental.

7.2 Temperature above the recommended range increases the stripping rate, but tends to cause attack of basis metal. Temperatures below the recommended range slow the rate of stripping. As the nickel contamination increases in the process higher temperature operation is recommended for maximum bath life.

7.3 Both additives are consumed in the stripping process. Frequent additions of 406 Immersion Stripper and 408 Immersion Stripper based on the quantity of nickel stripped are recommended to maintain a consistent stripping rate. For each increase in nickel concentration of 1.6 lb/100 gal (2 g/L), add 1.2 lb/100 gal (1.5 g/L) 408 Immersion Stripper and 0.06 lb/100 gal (0.7 g/L) 406 Immersion Stripper.

7.4 Chromium deposits must be stripped in anodic alkali solutions or other suitable products such as UDYLITE Electrolytic Chrome Stripper 486, then thoroughly rinsed prior to stripping in the UDYLITE Immersion Stripper 406.

8.0 ANALYTICAL PROCEDURES

Equipment Required

Spectrophotometer capable of reading absorbances in the ultraviolet range from 300 to 250 nanometers.

100 mL Volumetric flasks.

Pipettes (See each test for sizes).

500 mL Erlenmeyer flask.

Filter Paper - Whatman #2 or equivalent.

Funnel

Reagents Required

Sodium Hydroxide Solution:

40.0 g/L

Ferric Reagent:

Dissolve 100 grams of $FeCl_3 \cdot 6H_2O$ and 50 mL of reagent hydrochloric acid in 400 mL of D.I. water. Dilute to 500 mL with D.I. water.

Buffer Solution:

(Optional for nickel test if no A.A. is available)= Dissolve 50 grams of NH_4Cl and 400 mL of reagent ammonium hydroxide in 800 mL D.I. water. Dilute to 1 liter with D.I. water.

Murexide Indicator:

(Optional for nickel test) = Thoroughly mix 0.5 grams of pure murexide indicator with 100 grams of reagent sodium chloride.

Sodium Hydroxide:

200 grams/Liter (Optional for nickel test).

EDTA Solution:

0.1 Normal (Optional for nickel test).

Triethanolamine Solution:

50% (volume) - (Optional for nickel test).

DETERMINATION OF UDYLITE 408 IMMERSION STRIPPER

1. Pipette 1.0 mL of sample to be analyzed into a 100 mL volumetric flask. Dilute to 100 mL and mix well.

   NOTE: Perform Step 2A -OR- 2B next.

2A. If the sample is a FRESH BATH (no metals present - no parts stripped yet), pipette 2.0 mL of solution from Step #1 into another 100 mL volumetric flask. Proceed to Step #3.

2B. If the bath is USED and has nickel or other metals present, pipette 5.0 mL of solution from Step #A-1 into another 100 mL volumetric flask. Proceed to Step #A-3.

3. Add 10 mL of 40 g/L sodium hydroxide solution to flask from Step 2A or 2B.

4. Dilute to 100 mL and mix well.

5. Using Whatman #2 or equivalent filter paper, filter enough solution from Step 4 to fill a spectrophotometer cell. DO NOT OMIT THIS STEP EVEN IF SOLUTION APPEARS TO BE CLEAR.

6. Using D.I. water as a reference, record the absorbance of the filtered solution from Step 5 at 261 nanometers AND 290 nanometers.

7. Calculations:

$$\frac{[(361.9 \times A261) - (96.3 \times A290)]}{V} = \text{Grams/Liter of 408}$$

   Where V = Volume of diluted sample used in Step 2A OR 2B (either 2 mL or 5 mL)

   A261 and A290 = Absorbances from Step 6

   NOTE: If the absorbances in Step 6 are greater than 1.000 for a USED bath, a SMALLER SAMPLE must be taken in Step 2B from the diluted solution. Use the appropriate value for V in the above calculation formula.

DETERMINATION OF UDYLITE 406 IMMERSION STRIPPER

1. Pipette 2.0 mL of sample into a 100 mL volumetric flask.

2. Pipette 10.0 mL of ferric reagent into the flask. Dilute to the mark and mix well.

3. Pipette 10.0 mL of ferric reagent into another 100 mL volumetric flask. Dilute to the mark and mix well. This is ferric blank.

4. Using ferric blank as a reference, record the absorbance of solution from Step 6 at 550 nm.

5. Calculations

   g/L of 406

   = ABS550 x 3.48

   Where ABS550 = Absorbance reading from Step 4.

Nickel Determination

NOTE: The presence of iron can make nickel analysis by EDTA titration difficult or impossible. The preferred method of analysis is by atomic absorption.

9.0 WASTE TREATMENT

UDYLITE Immersion Stripper 406is an acidic process that will contain nickel that is removed during the stripping process. Small quantities of hydrogen sulfide are given off during the the stripping process. Ventilation is required. Because of the noxious odor of hydrogen peroxide, it is necessary to provide proper tank ventilation.

Waters used to rinse the racks after they have been stripped may be mixed directly with other plant waste streams prior to heavy metal removal. Concentrated dumps and spills should be collected and metered to treatment, or can be sent for offsite disposal.

The pH of the composite waste stream should be adjusted to between 8.5 to 10 to effect optimum heavy metal removal prior to discharge of the clarifier and/or polished effluent to POTW or receiving surface waters.

Local regulatory authorities must be consulted for regulations involving effluent discharge limits and offside sludge disposal. Most effluent treatment/recovery systems must accept several feed streams from different sources containing other materials. An optimum system should be provided by qualified specialists who can properly take into account the chemical properties of each feed stream.

IMMERSION STRIPPER 406

SECTION II - HAZARDOUS COMPONENTS

Components	Cas No.	Percentage	TLV OSHA ACGIH

-N O N E-

SECTION III - PHYSICAL DATA

Appearance and Odor: White solid with slight ammonia odor.

Solubility in Water:			Boiling Point:	NA
Negligible	<0.1%		Vapor Pressure:	NA
Slight	0.1 -1.0%		Percent Volatile By Volume	NA
Moderate	1.0-10.0%		Evaporation Rate	NA
Appreciable	>10.0%	x	Specific Gravity	NA
Complete(all proportions)			pH of 10% sol'n	6.2

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point (method used) None
Flammable/Explosive Limits LEL NA UEL NA

NFPA Code (0-4) Health - 0 Flammability - 0 Reactivity - 0

Extinguishing Media: Product will not burn.

Special Fire Fighting Procedures: Use media suitable for surrounding fire. Thermal decomposition may yield toxic oxides of sulfur and nitrogen.

Unusual Fire and Explosion Hazards: Cyanides or hydrogen sulfide may be generated when in contact with acids or oxidizing agents.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value: None known or established.

Effects of Overexposure:
Acute: Possible eye and skin irritant.
Chronic: None expected.
Principal Route of Exposure: Contact.

Emergency First Aid Procedures:

Eye: Flush with a directed stream of water for 15 minutes. Seek medical attention.

Skin: Wash with soap and water.

Inhalation: Remove to fresh air.

Swallowing: Drink water (2-3 glasses) to dilute. Seek medical

SECTION VI - REACTIVITY DATA

Stability: Stable

Incompatibility:
(Materials to Avoid): Acids, oxidizers

Hazardous Decomposition Products: Oxides of sulfur and nitrogen, hydrogen sulfide, hydrogen cyanide.

Hazardous Polymerization: Will not occur.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in case material is released or spilled:

Contain and place into a container suitable for transportation to a licensed waste treatment facility.

Waste Disposal Method:	Licensed waste treatment facility.	
EPA I.D. Number:	NA	RQ: 5000/2270

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation:
Local Exhaust: Yes Respiratory Protection: NIOSH dust mask

Protective Clothing:

Gloves:	butyl rubber or neoprene	Boots:	No
Chemical Goggles:	Yes	Other:	No
Full Face Shield:	No		

NOTE: Eye Fountain and Safety Shower must always be available.

SECTION IX - SPECIAL PRECAUTIONS

Handling & Storage:	Store away from acids and oxidizers.
Other:	None

SECTION X - SHIPPING INFORMATION

DOT Proper Shipping Name:		None		
Hazard Class:		None		
DOT Label(s):		None		
IATA:	Class:	NA	Packing Group:	NA
IMDGC	Class:	NA	Packing Group:	NA

UDYLITE IMMERSION STRIPPER 408

Proprietary Formulation

SECTION II - HAZARDOUS COMPONENTS

Components	Cas. No.	Percentage	TLV OSHA ACGIH
-N O N E-			

SECTION III - PHYSICAL DATA

Appearance and Odor: Yellow crystals or flakes with a bland odor.

Solubility in Water:				
			Boiling Point	NA
Negligible	<0.1%	---	Vapor Pressure	NA
Slight	0.1-1.0%	---	Percent Volatile by Vol	NA
Moderate	1.0-10.0%	X	Evaporation Rate	NA
Appreciable	>10.0%	---	Specific Gravity	3.7
Complete(all proportions)		---	pH of 10% sol'n	9.1

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point:
(method used) Flammable/Explosive Limits LEL N/A UEL N/A

not established.

NFPA Code (0-4) Health -0 Flammability - 0 Reactivity - 0

Extinguishing Media:

Water only.

Special Fire Fighting Procedures:

Product burns with a glowing ash. Thermal decomposition may release oxides of nitrogen and sulfur.

Unusual Fire and Explosion Hazards:

May detonated at high temperatures or upon sudden contact with sodium hydroxide.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value: None known or established.

Effects of Overexposure:

Acute: Possible eye and skin irritant.

Chronic: None expected.

Principal Route of Exposure: Contact.

Emergency First Aid Procedures:

Eye: Flush with a directed stream of water for 15 minutes. Seek medical attention.

Skin: Wash with soap and water.

Inhalation: Remove to fresh air.

Swallowing: Drink Water (2-3 glasses) to dilute. Seek medical attention.

SECTION VI - REACTIVITY DATA

Stability: Stable

Incompatibility
(Materials to Avoid):

Reducing agents, sodium hydroxide, flammable, combustibles

Hazardous Decomposition
Products:

Oxides of sulfur, nitrogen

Hazardous Polymerization: Will Not Occur

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in case material is released or spilled:

Contain and place into a container suitable for transportation to a licensed waste treatment facility.

Waste Disposal Method:

Licensed waste treatment facility.

EPA I.D. Number: NA RQ: NA

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation:

Local Exhaust: Yes Respiratory Protection: NIOSH dust mask

Protective Clothing:

Gloves:	butyl rubber or neoprene	Boots:	No
Chemical Goggles:	Yes	Other:	No
Full Face Shield:	No		

NOTE: Eye Fountain and Safety Shower must always be available.

SECTION IX - SPECIAL PRECAUTIONS

DOT Proper Shipping Name:		None		
Hazard Class:		None		
DOT Label(s):		None		
IATA	Class:	5.1	Packing Group:	II
IMDGC	Class:	5.1	Packing Group:	II

UDYLITE IMMERSION STRIPPER 460 PROCESS

1.0 INTRODUCTION

The UDYLITE Immersion Stripper 460 Process is designed for efficient stripping and electrodeposited nickel and electroless nickel* deposits from steel and steel alloy. When the UDYLITE 460 process is operated within the recommended ranges, basis metals are not attached even during prolonged immersion. With the use of UDYLITE 460, the immersion stripping process has been modified to maintain the strip rate and increase the nickel capacity which results in fewer dumps of the spent stripper solution. In addition, the UDYLITE 460 is an easy to handle nonfuming liquid.

2.0 SOLUTION COMPOSITION AND OPERATING CONDITIONS

2.1 Initial Solution Composition

	Concentration
UDYLITE 460 Immersion Parts Stripper	20% by volume
UDYLITE 451 Immersion Parts Stripper	8 oz/gal(60g/L)
Sodium Hydroxide	0.67 oz/gal(5 g/L)

UDYLITE 449 Immersion Parts Stripper (0.53 oz/gal) must be added to the operating solution if stripping nickel from brazed steel substrates.

*Some high phosphorus, aged and heat treated parts may be difficult to strip. consult your Udylite Representative.

2.2 Operating Condition

	Optimum	Range
Operating pH	10.5	10.2 to 12.0
Operating temperature	180 F	160 to 190 F

3.0 STRIPPING RATE

A new bath begins to strip at the following rates:

140 to 150 F (60 to 65.5 C)	1.0 to 1.4 mils/hr
160 to 170 F (71.1 to 76.8 C)	1.3 to 1.8 mils/hr
180 to 200 F (82.2 to 93.3 C)	2.0 to 2.5 mils/hr

As the bath is used and the total nickel stripped approaches 2.5 oz/gal (18.8 g/L) the stripping rates fall off significantly.

To regenerate the bath to the original stripping rates, additions of both components must be made according to the following ratios.

UDYLITE 451 Immersion Parts Stripper	1.0 oz/gal
UDYLITE 460 Immersion Parts Stripper	2.5% by volume
UDYLITE 449 Immersion Parts Stripper (if needed)	0.7 oz/gal

NOTE: THE ABOVE ADDITIONS CAN BE CONTINUED UNTIL APPROXIMATELY 8 TO 9 OZ/GAL (60 TO 67.5 g/L) TOTAL NICKEL STRIPPED HAS BEEN ACHIEVED. THE TOTAL NICKEL CAPACITY IS BASED ON THE AMOUNT OF NICKEL PROCESSED, NOT ON THE AMOUNT OF SOLUBLE NICKEL FOUND BY ANALYSIS.

4.0 EQUIPMENT REQUIREMENTS

Tank	Steel, stainless steel, Pyrex glass, hard rubber lined steel or polypropylene lined steel.
Heater	Steel or stainless steel.
Agitation	Cathode rod agitation and/or power mixer to circulate the solution preferred.
Ventilation	Solution is classified D-2 by ANSI. Ventilation IS recommended.

5.0 PROCESS MATERIAL REQUIRED

	Specify Product Code
UDYLITE 460 Immersion Parts Stripper	102832
UDYLITE 449 Immersion Parts Stripper	100400
UDYLITE 451 Immersion Parts Stripper	100402
Sodium Hydroxide	100164

6.0 PROCESS MAKE-UP

For each 100 gallons (378 liters)

1. To the clean stripping tank, add warm water to fill tank to 1/4 operating level.

2. While stirring continuously, slowly add 50 pounds (22.7 Kg) 451 Immersion Parts Stripper, 4.2 pounds (1.9 Kg) sodium hydroxide and 20 gallons (75.7 liters) 460 Immersion Parts Stripper. Make sure each component is dissolved prior to adding the other components. (A power mixer is preferred for stirring.)

   WARNING! UDYLITE 460 IMMERSION PARTS STRIPPER AND SODIUM HYDROXIDE ARE HIGHLY ALKALINE. 451 IMMERSION STRIPPER IS A STRONG OXIDIZER AGENT. ALL ARE ALLERGENIC AND CAN CAUSE SEVERE BURNS ALONE OR TOGETHER IN SOLUTION. AVOID CONTACT WITH SKIN AND EYES. WEAR

PROTECTIVE CLOTHING. FACE MASK AND CHEMICAL SAFETY GOGGLES MUST BE WORN BY OPERATOR. FLUSH EXPOSED AREAS WITH LARGE QUANTITIES OF WATER. WASH SKIN WITH SOAP AND WATER. SEEK MEDICAL AID IF BURN OR IRRITATION PERSISTS.

3. If required, 3.3 pounds (1.5 Kg) UDYLITE 449* Immersion Parts Stripper should be added.

4. Adjust the solution to its operating volume with water. Mix thoroughly.

5. Adjust the pH to the recommended level of 10.5. Use sodium hydroxide to raise the pH or diluted glacial acetic acid to lower the pH.

6. Adjust the bath temperature to 180 F. (82 C).

7. The UDYLITE Immersion Stripper 460 Process is now ready to use.

7.0 PROCESS MAINTENANCE AND CONTROL

7.1 Daily checks of pH are required. The pH must be maintained at the 10.2 to 12.0 level. Use sodium hydroxide to raise the pH, or glacial acetic acid to lower the pH. High pH levels will decrease stripping rates.

7.2 Concentrations of UDYLITE 460 Immersion Parts Stripper below 10% by volume will cause very slow rates of stripping. The stripping rate may be increased with incremental addition of UDYLITE 460 Immersion Parts Stripper.

7.3 When stripping nickel from brazed steel substrates, UDYLITE 449 Immersion Parts Stripper is used. Low concentrations of UDYLITE 449 Immersion Parts Stripper will result in attack on the brazed steel areas. High concentrations of UDYLITE 449 Immersion Parts Stripper will have no adverse effects.

7.4 To prevent premature decomposition of components in UDYLITE Immersion Stripper 460 operating bath, the solution temperature must be maintained at ambient levels during the idle periods and the tank kept covered.

7.5 Stripping rates are highly dependent on temperature with the optimum stripping rate occurring within the 180 to 190 F (77 to 88 C) temperature range. Maintaining optimum temperature is particularly important when stripping electroless nickel deposits.

7.6 Chromium deposits overlaying electroplated nickel deposits must be completely removed prior to stripping of the nickel deposits. Chromium deposits may be stripped in anodic alkali solutions or in 50% v/v hydrochloric acid and water, followed by thorough rinsing.

7.7 Parts which have been chromium-stripped, or "soiled" or heat treated electroless nickel coated parts must be activated prior to stripping in Immersion Stripper 460 Process. Activation is accomplished by immersion in cathodic UDYLITE UDYPREP 345 or in 50% v/v hydrochloric acid and water for up to two minutes, followed by thorough rinsing.

*Consult your Udylite Technical Representative.

7.8 Solution Maintenance - If a constant stripping rate is desired, the stripper solution can be maintained with the following additions; for every 5.0 pounds of nickel stripped:

6.3 lbs.	UDYLITE 451 Immersion Parts Stripper
2.5 gallons	UDYLITE 460 Immersion Parts Stripper

Additions of UDYLITE 451 Immersion Parts Stripper and UDYLITE 460 Immersion Parts Stripper must be made at the same proportions to maintain stripping until the bath becomes too viscous to agitate.

7.9 Solution discharge from tank can be minimized by use of a mist spray rinse over the strip tank as the parts are removed from the tank, or by use of a recovery rinse which can be returned to the strip tank.

8.0 ANALYTICAL PROCEDURES

The following analytical procedures are recommended for use by personnel who have been trained always to use laboratory practices which are deemed safe and prudent by the chemical industry. Such practices include the use of suitable personal protective equipment; the use of proper equipment; the use of proper methods of handling all chemicals; and the overall use of safe laboratory procedures.

ANALYSIS OF UDYLITE IMMERSION STRIPPER 460 SOLUTIONS

Reagent Required

Sodium Chloride Solution - Saturated
Sulfuric Acid Solution - 1N
Standard 0.1N Hydrochloric Acid Solution

Equipment Required

1 - Beaker - 250 mL
2 - Volumetric Flasks - 100 mL
1 - Pipette - 1.0 mL
1 - Pipette - 2.0 mL
1 - Magnetic Stirrer
1 - pH Meter
1 - UV Recording Spectrophotometer
equipped with 1.0 cm silica cells

Procedure

ESTIMATION OF UDYLITE 460 IMMERSION PARTS STRIPPER

1. Pipette 2.0 mL of the sample to be analyzed into a 250 mL beaker.

2. Add with a graduate, 50 mL of saturated sodium chloride solution.

3. Using a pH meter and a magnetic stirrer, titrate with 0.1N hydrochloric acid solution to a pH of 9.0.

4. % of volume UDYLITE 460 Immersion Parts Stripper = V x N x 6.8.

   Where V = mL of hydrochloric acid solution used in Step 3
   N = normality of the hydrochloric acid used in Step 1

DETERMINATION OF UDYLITE 451 Immersion Parts Stripper

1. Dilute 2 mL sample to 100 mL with DI water.

2. Take 1 mL of dilution, add 10 mL of 1 N sulfuric acid and dilute to 100 mL with DI water.

3. Measure absorbance in 1 gram quartz cells witn DI water as reference.

4. Record absorbance of 360 NM, 320 NM and 260 NM.

   For old baths:

   [A260 - A360] - [2.5 (A320 - A360)] x 16.4=oz/gal 451

   For new baths:

   [A260 - A360] - [5 (A340 - A3600)] x 16.4 = oz./gal 451

9.0 WASTE DISPOSAL

The UDYLITE Immersion Stripper 460 is an alkaline solution containing nickel, ethylene amines, and strong chelators. The system is a zero discharge process achieved by rinsing parts above the UDYLITE Immersion Stripper 460 or recovering and combining rinses with the UDYLITE Immersion Stripper 460.

The UDYLITE Immersion Stripper 460 does not contain cyanide, phosphate, silicates or phenolics.

The UDYLITE Immersion Stripper 460 must only be disposed by an EPA approved waste disposal/treatment facility. This product cannot be treated as a conventional metal finishing waste.

UDYLITE 460 Immersion Parts Stripper
Proprietary Formulation

SECTION II - HAZARDOUS COMPONENTS

COMPONENTS	CAS NO.	%	TLV OSHA ACGIH	
Ethylenediamine	107-15-3	50-60	25 mg/M3	OSHA Z H

SECTION III - PHYSICAL DATA

Appearance and Odor: Colorless to light yellow liquid with amine odor.

Solubility in Water:		Boiling Point:	NA
Negligible <0.1%	---	Vapor Pressure	NA
Slight 0.1-1.0%	---	Percent Volatile by Volume	NA
Moderate 1.0-10.0%	---	Evaporation Rate	NA
Appreciable >10.0%	---	Specific Gravity	0.980
Complete(all proportions)	X	pH	12.9

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point-235 F - OC Flammable/Explosive Limits LEL-NA UEL-NA
(method used)

NFPA Code (0-4) Health - 2 Flammability - 0 Reactivity - 0

Extinguishing Media: Product will not burn. Use media suitable for surrounding fire.

Special Fire-Fighting Procedures: Wear self-contained breathing apparatus and full protective clothing.

Unusual Fire and Explosion Hazards: None Known.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value: 25 mg/M3

Effects of Exposure:

Acute: Corrosive to eyes, skin and mucous membranes.

Chronic: Corrosive to eyes, skin and mucous membranes.

Principal Route of Exposure: Skin contact, ingestion, inhalation.

Emergency First Aid Procedures:

Eye:	Flush with a directed stream of water for 15 minutes while forcibly holding eyelid open. Seek medical attention.
Skin:	Immediately flush with water. Seek medical attention.
Inhalation:	Remove to fresh air. Seek medical attention.
Swallowing:	Dilute by drinking 3-4 glasses of water. Do not induce vomiting. Seek medical attention.

SECTION VI - REACTIVITY DATA

Stability: Stable

Incompatibility: (Materials to Avoid)	Organic acids, oxidizing agents, aldehydes.
Hazardous Decomposition Products:	Carbon monoxide and/or dioxide, oxides of nitrogen

Hazardous

Polymerization:
Will not occur.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in case material is released or spilled:

Absorb with inert absorbent, contain and place into a lined container properly labeled for disposal.

Waste Disposal Method: Licensed waste treatment facility.

EPA I.D. Number: D002 RQ: (100/45.4)

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation:

Local Exhaust: Yes

Respiratory Procection: Cartridge respirator required if TLV is approached.

Protective Clothing:

Gloves:	Butyl rubber or neoprene
Chemical Goggles:	Yes
Full Face Shield:	Yes
Boots:	Yes
Other:	Full protective clothing

NOTE: Eye Fountain and Safety Shower must always be available.

SECTION IX - SPECIAL PRECAUTIONS

Handling & Storage: Store away from acids and oxidizers.

Other: Store only in original container.

SECTION X - SHIPPING INFORMATION

DOT Proper Shipping Name:		Ethylenediamine Solution UN 1604	
Hazard Class:		Corrosive Material	
DOT Label(s):		Corrosive 8	
IATA	Class:	8	Packing Group: II
IMDGC	Class:	8	Packing Group: II

UDYLITE 449 IMMERSION STRIPPER

Proprietary Formulation

SECTION II - HAZARDOUS COMPONENTS

Components	Cas No.	Percentage	TLV OSHA ACGIH
-N O N E-			

SECTION III - PHYSICAL DATA

Appearance and Odor: White to off-white solid with no odor.

Solubility in Water:				
negligible	<0.1%	---	Vapor Pressure	NA
Slight	0.1-1.0%	---	Percent Volatile by Vol	NA
Moderate	1.0-10.0%	---	Evaporation Rate	NA
Appreciable	>10.0%	X	Specific Gravity	>1.0
Complete(all proportions)		---	pH	NA
			Boiling Point	NA

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: None Flammable/Explosive Limits LEL N/A UEL N/A
(Method Used)

NFPA Code (0-4) Health - 0 Flammability - 0 Reactivity - 0

Extinguishing Media:

Product will not burn.

Special Fire Fighting Procedures:

Use media suitable for surrounding fire.

Unusual Fire and Explosion Hazards:

None known.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value: None Known or established

Effect of Overexposure:

Acute: None expected.

Chronic: Possible eye and skin irritant.

Principal Route of Exposure: Contact.

Emergency First Aid Procedures:

Eye: Flush with a directed stream of water for 15 minutes.

Skin: Wash with soap and water.

Inhalation: Remove to fresh air.

Swallowing: Drink water (2-3 glasses) to dilute.

SECTION VI - REACTIVITY DATA

Stability: Stable

Incompatibility:
(Materials to Avoid):

None known

Hazardous Decomposition
Products:

None

Hazardous Polymerization: Will Not Occur

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in case material is released or spilled:

Contain and place into a container suitable for transportation to a licensed wasted treatment facility.

Waste Disposal Method:

Licensed waste treatment facility.

EPA I.D. Number: NA RQ: NA

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation:

Local Exhaust: Yes Respiratory Protection: NIOSH dust mask

Protective Clothing:

Gloves:	Butyl rubber or neoprene	Boots:	No
Chemical Goggles:	Yes	Other:	No
Full Face Shield:	No		

NOTE: Eye Fountain and Safety Shower must always be available.

SECTION IX - SPECIAL PRECAUTIONS

Handling & Storage:

No special requirements.

Other:

None

SECTION X - SHIPPING INFORMATION

DOT Proper Shipping Name:		None		
Hazard Class:		None		
DOT Label(s):		None		
IATA	Class:	NA	Packing Group:	NA
IMDGC	Class:	NA	Packing Group:	NA

UDYLITE 451 IMMERSION STRIPPER

Proprietary Formulation

SECTION II - HAZARDOUS COMPONENTS

Components	Cas No.	Percentage	TLV OSHA ACGIH
-N O N E-			

SECTION III - PHYSICAL DATA

Appearance and Odor: Off-white to light yellow powder with mild odor.

Solubility in Water:				
Negligible	<0.1%	---	Vapor Pressure	NA
Slight	0.1-1.0%	---	Percent Volatile by Vol	NA
Moderate	1.0-10.0%	x	Evaporation Rate	NA
Appreciable	>10.0%	---	Specific Gravity	NA
Complete(all proportions)		---	pH	NA

Boiling Point NA

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: None Flammable/Explosive Limits LEL N/A UEL N/A
(method used)

NFPA Code (0-4) Health - 0 Flammability - 0 Reactivity -0

Extinguishing Media:

Product will not burn.

Special Fire Fighting Procedures:

Use media suitable for surrounding fire.

Unusual Fire and Explosion Hazards:

Grinding in presence of dry alkali (sodium or potassium hydroxide) may cause autoignition. Thermal decomposition may release oxides of nitrogen.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value: None known or established.

Effects of Overexposure:

Acute: None expected.

Chronic: Possible eye and skin irritant.

Principal Route of Exposure:Contact.

Emergency First Aid Procedures:

Eye:

Flush with a directed stream of water for 15 minutes. Seek medical attention.

Skin: Wash with soap and water.

Inhalation: Remove to fresh air.

Swallowing: Drink water (2-3 glasses) to dilute. Seek medical attention.

SECTION VI - REACTIVITY DATA

Stability: Stable

Incompatibility
(Materials to Avoid):

Reducing agents, flammables, combustibles.

Hazardous Decomposition
Products:

Oxides of nitrogen

Hazardous Polymerization: Will not Occur

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in case material is released or spilled:

Contain and place into a container suitable for transportation to a licensed waste treatment facility.

Waste Disposal Method:

Licensed waste treatment facility.

EPA I.D. Number: NA RQ: NA

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation:

Local Exhaust: Yes Respiratory Protection: NIOSH dust mask

Protective Clothing:

Gloves:	butyl rubber or neoprene	Boots:	No
Chemical Goggles:	Yes	Other:	No
Full Face Shield:	No		

NOTE: Eye Fountain and Safety Shower must always be available.

SECTION IX - SPECIAL PRECAUTIONS

Handling & Storage:

Store away from incompatibles in Section VI and heat sources.

Other:

None

SECTION X - SHIPPING INFORMATION

DOT Proper Shipping Name:		None		
Hazard Class:		None		
DOT Label(s)		None		
IATA	Class:	NA	Packing Group:	NA
IMDGC	Class:	NA	Packing Group:	NA

UDYSTRIP 7000

The UDYLITE UDYSTRIP 7000 Process is designed to electrolytically strip heavy copper deposits without etch or hydrogen embrittlement from most ferrous substrates. Because the operating life of the UDYSTRIP 7000 is indefinite, frequent batch dumps associated with the use of immersion stripping processes are eliminated. With regular maintenance additions of XP-116 Maintenance, an average stripping rate of 2.29 microns (0.00009 inches per minute) may be consistently maintained. No cyanides, phenol derivatives, amines, or hexavalent chromium compounds are used in the UDYSTRIP 7000 Process.

INITIAL SOLUTION COMPOSITION

XP-115A Make-Up	50% by volume

OPERATING CONDITIONS

	Optimum	Range
Temperature	31 C (90 F)	21 C to 38 C (70 F to 100 F)
pH	6.5	6.0 to 7.5
Anode Current Density	10 A/dm2 (100 ASF)	1 to 15 A/dm2 (10 to 150 ASF)
Cathode Current Density	2.5 A/dm2 (25 ASF)	0.25 to 3.7 A/dm2 (2 to 37 ASF)
Cathode to Anode Ratio	4:1	3:1 to 6:1
Agitation	Mechanical or solution agitation. Air may be used.	
Voltage	4 to 9 volts	

EQUIPMENT REQUIREMENTS

Tanks	Koroseal or PVC lined. To accommodate sludge formation, allow 18 inches between tank bottom and bottom of racks.
Heating	Teflon coil or quartz immersion heater.
Cooling	Teflon coils, when required.
Ventilation	Required
Cathodes	Steel, nickel plated to 0.5 mil minimum (do not use perforated cathodes).

MAKE-UP PROCEDURE

For each 378 liters (100 gallons):

1. Add 95 liters (25 gallons) of water to the clean process tank.

2. With CONTINUOUS stirring, slowly add 190 liters (50 gal) of XP-115A Make-Up.

3. Bring solution volume to operating level with water and mix thoroughly.

4. Adjust pH to 6.5 with 28% Ammonium Hydroxide. pH can be lowered with 42 degree Baume nitric acid.

WARNING! AMMONIUM HYDROXIDE AND NITRIC ACID ARE CORROSIVE AND CAN CAUSE SEVERE BURNS TO BOTH SKIN AND EYES. AVOID BREATHING ANY FUMES BY USING ADEQUATE VENTILATION AND/OR APPROVED RESPIRATORY EQUIPMENT. AVOID CONTACT WITH EYES AND SKIN. WEAR FULL PROTECTIVE CLOTHING, FACESHIELD AND CHEMICAL GOGGLES. IN CASE OF CONTACT, FLUSH THE EXPOSED AREA WITH CLEAN, COLD WATER. IN CASE OF INJURY CONSULT A PHYSICIAN.

5. The UDYSTRIP 7000 Process is now ready for use.

PROCESS CONTROL PROCEDURES

XP-116A Maintenance

The operating bath consists of a balanced mixture of conductivity salts, activators, and inhibitors. Maintenance of the process is accomplished through regular additions of the XP-116A Maintenance, and is based on ampere-hour consumptions. Until more accurate figures bases on operating experience are established, an addition rate of 3785 mL (1 gallon) XP-116A Maintenance per 1500-3000 ampere-hours is suggested. Low Replenisher concentrations will result in slow stripping rates and base metal etch. High concentrations are generally not harmful.

pH

A slow rise in pH is normal in the operation of this process.

The pH may be lowered with 42 degree Baume' nitric acid, or raised with diluted 28% ammonium hydroxide. The recommended operating pH range is 6.0 to 7.5. Operation of the process at a pH higher than recommended will result in a slower stripping rate and excessive sludge formation. Base metal etch will occur at low pH values.

Temperature

The UDYSTRIP 7000 process is operated within a temperature range of 21 C to 38 C (70 F to 100 F). Temperatures exceeding 38 C (100 F) will result in base metal attack. Temperatures below 21 C (70 F) will cause lower bath conductivity, slow stripping rates, excessive gassing at the cathodes and precipitation of salts from solution. Process solutions operating on a continuous basis may require cooling.

Current Density

Attempting to strip at excessive current densities in the UDYSTRIP 7000 Process will passivate the copper and will require reactivation in 50% by volume hydrochloric acid. The part may them be stripped at recommended current densities.

Surface etch, especially with high carbon steels, will be encountered if current densities exceeding the recommended range are used. Operation of the UDYSTRIP 7000 at low current densities will result in slow stripping rates but is not harmful to the basis metal.

Racking

Parts to be stripped must be racked with a positive contact. Plating racks with steel contacts can be used. Auxiliary steel cathodes are recommended for parts with deep recesses or holes. The integrity of rack coatings must be preserved to prevent damage to racks. Heavy build up on racks will divert current from work and result in slow stripping rates.

Stripping Cycle

Freshly plated copper parts may be stripped directly in the UDYSTRIP 7000 Process. If scale, oil or grease is present on the part surface, they must first be properly cleaned before stripping. Build-up of chlorides or fluorides which can result from drag-in must be avoided.

1. Preclean (if necessary)
2. Strip in UDYSTRIP 7000
3. Spray rinse/cold water rinse
4. Hot water rinse
5. Spray/immerse with rust preventative

Optimum Stripping Rate

	Stripping Rate/Min. (10 A/dm2; 100 ASF)	
Temperature	Microns	Inches
38 C (100 F)	25	.0001"

SLUDGE REMOVAL

After a period of operation, accumulated sludge will reach the racks and it will be necessary to remove it. Allow the sludge to settle to 2-4 hours, decant into a clean holding tank and remove sludge by shoveling into lined drums or other suitable containers. The sludge will consist of copper salts which can be reclaimed.

Replenishment of additives are required after the desludging procedure due to solution loss. For every 3.78 liters (1 gal) of solution lost, add 1.89 liters (0.5 gal.) of XP-115A Make-Up. Adjust to final operating volume with water and check pH (6.5 optimum).

An optional method of sludge removal utilizing continuous filtration can be used with UDYSTRIP 7000 solutions. A minimum of one solution turnover per hour is recommended.

WASTE TREATMENT

When properly maintained, the UDYSTRIP 7000 process will have an indefinite life, which will preclude batch dumps.

Wastes in the rinse water following the stripping operation may be treated, if necessary, by:

1. Chlorination of ammonium ions.

2. Neutralization and precipitation of dissolved copper.

In all cases, consult with pertinent waste treatment authorities for specific restrictions in your area.

DETERMINATION OF CARRIER

Equipment Required

Boiling beads or chips
1 - burette - 50 mL
1 - Erlenmeyer flask 300 mL
1 - Graduate - 50 mL
1 - Kjaldahl flask - 500 mL
1 - Volumetric pipette - 1.0 mL
1 - Distilling apparatus such as E. H. Sargent S-63410 or equivalent

Reagents Required

Boric Acid Collecting Solution:

Dissolve 20 g of boric acid in 1 liter of distilled water.

Mixed Indicator:

Mix 50 mL of 0.2% methyl red in ethanol with 25 mL of 0.2% methylene blue in ethanol.

Sodium Hydroxide Solution 20%:

Dissolve 200 g of reagent sodium hydroxide in 1 liter of distilled water.

Standard Hydrochloric Acid Solution - 0.1N

Procedure

1. Place 50 mL of Boric Acid collecting solution and 10 to 15 drops of mixed indicator in a 300 mL Erlenmeyer flask. Place the flask in the receiving position on the distilling apparatus. (The Kjeldahl delivery tube should extend below the level in the receiving flask.)

2. Pipette 1.0 mL of the solution to be analyzed into the Kjeldahl flask.

3. Add several boiling beads to the Kjeldahl flask, 150 mL of distilled water and 20 mL of 20% sodium hydroxide solution. Connect the flask immediately to the distilling apparatus so that the distillate is caught into the Erlenmeyer flask. Swirl gently to mix. Turn on the condenser cooling water and also the distilling flask heater.

4. Continue the distillation until 75 to 100 mL of the distillate have distilled into the receiving flask. (Total volume in the receiving flask will be 125 to 150 mL.)

5. Remove the receiving flask from the distillation apparatus and titrate the contents with 0.1N hydrochloric acid from green to reddish violet endpoint.

6. Grams/L Carrier V x N x 17.0

   V = mL of 0.1N HCl required to titrate receiving flask.
   N = normality of the 0.1N HCl.

NOTE: USUALLY STEP 4 IS COMPLETE AFTER 75 TO 100 mL OF DISTILLATE HAS BEEN COLLECTED. HOWEVER, TO ENSURE COMPLETE RECOVERY, DISTILLATION CAN BE CONTINUED WHILE THE FIRST 75 TO 100 mL IS TITRATED AS INDICATED IN STEP 5.

THE SECOND VOLUME IF DISTILLATE IS NOW ADDED TO THE SOLUTION TITRATED IN STEP 5. IF THE INDICATOR TURNS GREEN AFTER THE ADDITION OF THE SECOND DISTILLATED, THE CARRIER HAS NOT BEEN RECOVERED. IF THE COLOR REMAINS VIOLET, THE DISTILLATION AND RECOVERY OF THE CARRIER IS COMPLETE.

ADJUSTMENT: Optimum Carrier concentration is 51 g/L (6.8 oz/gal). A 1.0% by volume addition of XP-116A Maintenance will raise the carrier concentration of the operation solution 1 g/L.

DETERMINATION OF INHIBITOR
(Panel Evaluation Method)

Equipment Required

1 - Beaker - 500 mL
2 - Mild steel cathodes (approx. 1.25" x 8")
1 - Ruler
1 - Laboratory rectifier (capacity: 10 amps/15 volts)
1 - Heat supply to maintain bath in the range of 32 - 38 C (90 - 100 F)
Mild steel test panels with a minimum of 0.0005" copper plate (using 1.25" wide mild steel stock)

Reagents Required

50% by volume Hydrochloric Acid Solution

Procedure

1. To the 500 mL beaker, add 400 mL UDYSTRIP 7000 stripping solution.

2. Heat the solution to reach 32 C (90 F).

3. Mark off 76mm x 32mm (3" x 1.25") on the copper plated panel.

4. Activate the prepared copper panel in the 50% HCl solution for one minute. Rinse well.

5. Connect the positive (+) lead of the rectifier to "A" in Figure I, and the negative (-) lead to "C" in Figure I.

6. Set the rectifier to 5.2 amps. (This is equivalent to 100 ASF.)

7. Strip for 20 minutes. Maintain constant temperature.

8. Remove the panel (work), rinse in warm water, paper dry and examine the mild steel panels (base metal) for any changes in appearance (etching and/or pitting). Evaluation of the steel after stripping can be done by comparing the stripped steel with nonplated steel of the same grade.

9. If etching and/or pitting occurs, add XP-238A Inhibitor in increments of 5 g/L (0.67 oz/gal).

   a. Adjust pH to 6.5. Use 28% ammonium hydroxide to raise the pH or 42 degree Baume nitric acid to lower.

b. Rerun the 20 minute stripping test until no attack on the base metal is observed.

ADJUSTMENT: When it is necessary to raise the Inhibitor concentration of the working solution, add XP-238A Inhibitor in 5 g/L (0.67 oz./gal) increments. The total quantity of XO-238A Inhibitor added should not exceed 20 g/L (2.7 oz/gal).

If the attack on the base metal persists, the problem can originate from other sources. Consult your UDYSTRIP 7000 Operating Instructions or your Udylite Technical Service Representative.

STRIPPING DIAGRAM

Figure I

UDYLITE XP-116A MAINTENANCE

Proprietary Formulation

SECTION II - HAZARDOUS COMPONENTS

Hazardous Components	Cas No.	Percentage	TLV OSHA ACGIH
Ammonium Nitrate	6484-52-2	50 to 60	NA

SECTION III - PHYSICAL DATA

Appearance and Odor: Colorless to light yellow liquid with no odor.

Solubility in Water:				
			Boiling Point:	NA
Negligible	<0.1%	---	Vapor Pressure	NA
Slight	0.1-1.0	---	Percent Volatile by Vol.	NA
Moderate	1.0-10.0%	---	Evaporation Rate	NA
Appreciable	>10.0%	---	Specific Gravity	1.235-1.288
Complete(all proportions)		x	pH	3.2 - 5.0

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: None Flammable/Explosive Limits LEL N/A UEL N/A
(method Used)

NFPA Code (0-4) Health - 0 Flammability - 0 Reactivity - 1

Extinguishing Media:

Water

Special Fire Fighting Procedures:

Thermal decomposition will release toxic nitrogen oxide gases.

Unusual Fire and Explosion Hazards:

If product is allowed to dry, the material is an oxidizer. Do not contain. Explosion possible.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value: None known or established.

Effect Overexposure:

Acute: None expected.

Chronic: Possible irritant.

Principal Route of Exposure: Eye and skin contact.

Emergency First Aid Procedures:

Eye: Flush with a directed stream of water for 15 minutes. Seek medical attention.

Skin: Wash with soap and water. Remove contaminated clothing.

Inhalation: Remove to fresh air. Seek medical attention.

Swallowing: Dilute by drinking 3-4 glasses of water. Induce vomiting by administering syrup of ipecac. Seek medical attention.

SECTION VI - REACTIVITY DATA

Stability: Stable

Incompatibility:
(Materials to Avoid):

Organics, reducing agents, combustibles, flammables.

Hazardous Decomposition
Products:

Nitrogen oxide gases.

Hazardous Polymerization: Will not Occur.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in case material is released or spilled:

Absorb with inert absorbent and place into a lined container properly labeled for disposal.

Waste Disposal Method:

Licensed waste treatment facility.

EPA I.D. Number: NA RQ: NA

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation:

Local Exhaust: Yes Respiratory Protection: No

Protective Clothing:

Gloves:	butyl rubber or neoprene	Boots:	Yes
Chemical Goggles:	Yes	Other:	protective clothing
Full Face Shield:	No		

NOTE: Eye Fountain and Safety Shower must always be available.

SECTION IX - SPECIAL PRECAUTIONS

Handling & Storage:

Store away from reducing agents, combustibles, flammables.

Other:

Organics, sources of heat and direct sunlight.

SECTION X - SHIPPING INFORMATION

DOT Proper Shipping Name:		Not required.		
Hazard Class:		None		
DOT Label(s)		Not required.		
IATA	Class:	NA	Packing Group:	NA
IMDGC	Class:	NA	Packing Group:	NA

UDYLITE XP-115A MAKE-UP

Proprietary Formulation

SECTION II - HAZARDOUS COMPONENTS

Components	Cas No.	Percentage	TLV OSHA ACGIH
Ammonium Nitrate	6484-52-2	50 to 60	NA

SECTION III - PHYSICAL DATA

Appearance and Odor: Colorless to light yellow liquid with no odor.

Solubility in Water:			
Negligible	<0.1% ---	Vapor Pressure	NA
Slight	0.1-1.0%---	Percent Volatile by Vol.	NA
Moderate	1.0-10.0% ---	Evaporation Rate	NA
Appreciable	>10.0% ---	Specific Gravity	1.235-1.288
Complete (all proportions)	X	pH	3.2 - 5.0
		Boiling Point	NA

SECTION
IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: None Flammable/Explosive Limits LEL N/A UEL N/A
(Method Used)

NFPA Code (0-4) Health - 0 Flammability - 0 Reactivity - 1

Extinguishing Media:

Water

Special Fire Fighting Procedures:

Thermal decomposition will release toxic nitrogen oxide gases.

Unusual Fire and Explosion Hazards:

Do not contain. Explosion possible.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value: None known or established.

Effects of Overexposure:

Acute: None expected.

Chronic: Possible irritant.

Principal Route of Exposure: Eye and skin contact.

Emergency First Aid Procedures:

Eye:	Flush with a directed stream of water for 15 minutes. Seek medical attention.
Skin:	Wash with soap and water. Remove contaminated clothing.
Inhalation:	Remove to fresh air. Seek medical attention.
Swallowing:	Dilute by drinking 3-4 glasses of water. Induce vomiting by administering syrup of ipecac. Seek medical attention.

SECTION VI - REACTIVITY DATA

Stability: Stable

Incompatibility:
(Materials to Avoid):

Organics, reducing agents, combustible, flammables.

Hazardous Decomposition
Products:

Nitrogen oxide gases.

Hazardous Polymerization: Will not Occur.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in case material is released or spilled:

Absorb with inert absorbent and place into a lined container properly labeled for disposal.

Waste Disposal Method:

Licensed waste treatment facility.

EPA I.D. Number: NA RQ: NA

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation:

Local Exhaust: Yes Respiratory Protection: No

Protective Clothing:

Gloves:	Butyl rubber or neoprene	Boots:	Yes
Chemical Goggles:	Yes	Other:	protective clothing
Full Face Shield:	No		

NOTE: Eye Fountain and Safety Shower must always be available.

SECTION IX - SPECIAL PRECAUTIONS

Handling & Storage:

Store away from reducing agents, combustibles, flammables.

Other:

Organics, sources of heat and direct sunlight.

SECTION X - SHIPPING INFORMATION

DOT Proper Shipping Name:		Not required.		
Hazard Class:		None		
DOT Label(s)		Not required.		
IATA	Class:	NA	Packing Group:	NA
IMDGC	Class:	NA	Packing Group:	NA

XPS-306 IMMERSION NICKEL STRIPPING PROCESS

INTRODUCTION

The XPS-306 Immersion Part Stripper Process is a cyanide-free amine-free, phosphate-free system designed to strip electroplated, sulfur free and sulfur containing nickel deposits from steel substrates. The Process is highly stable, simple to control and economical to operate. When this Process is operated within the recommended ranges, there is no substantial attack on the steel even during prolonged immersion time.

INITIAL SOLUTION COMPOSITION

XPS-306B	50% by volume
XPS-307A	60 g/L (8 oz/gal)

XPS-306B and XPS-307A are used for both formulation of solution and periodic solution regeneration.

OPERATING CONDITIONS

	Optimum	Range
Temperature	60 C (140 F)	54 to 71 C (130 to 150 F)
pH	9.3	9.0 to 9.5

STRIPPING RATES

Stripping rates varies according to the temperature of the solution. The following rates for electrodeposited nickel apply to a freshly prepared solution.

NEW SOLUTION

60 C (140 F)	1.5 mils/hr Nickel Stripped
Room Temperature	0.55 mils/hr Nickel Stripped

OPERATING SOLUTION (15 TO 40 g/L Nickel Dissolved)

60 C (140 F)	1.0 mils/hr Nickel Stripped
Room Temperature	0.25 mils/hr Nickel Stripped

EQUIPMENT

Requirements:	Koroseal lines, Polyprolylene or Stainless Steel are acceptable.

Tank:	TANKS MUST BE DEEP ENOUGH TO ACCOMMODATE TWELVE INCHES OF SLUDGE BELOW THE BOTTOM OF THE LONGEST PART.
Heating Coil:	Teflon or Quartz Immersion Heater.
Agitation:	Cathode rod and/or power mixer with Teflon or plastic coated shaft and blades to circulate the solution is preferred. Do not use air agitation.
Ventilation*:	Required.

*Because of the noxious odor of ammonia fumes which may be present, it is necessary to provide proper tank ventilation.

Ventilation requirements are generally 250 cubic feet per minute of exhaust per each square foot of exposed surface area of tank.

MAKE-UP PROCEDURE

For each 378 liters (100 gallons) of solution:

1. After thoroughly leaching and rinsing the process tank, add 95 liters (25 gallons) of water.

2. With continuous stirring, carefully add 189 liters (50 gal) of XPS-306B.

   WARNING! XPS-306B IS AN ALKALINE SOLUTION (pH 9.0-9.2). XPS-307A IS A STRONG OXIDIZING AGENT. WEAR PROTECTIVE CLOTHING, FACIAL MASK AND CHEMICAL SAFETY GOGGLES. FLUSH EXPOSED AREAS WITH LARGE QUANTITIES OF CLEAN WATER. WASH SKIN WITH SOAP AND WATER. IN CASE OF INJURY, CONSULT A PHYSICIAN.

3. Mix thoroughly.

4. With continuous stirring, carefully add 22.7 kg (50 lbs.) of XPS-307A.

5. Adjust the solution to just below operating volume with water. Mix thoroughly.

6. Adjust the pH if needed to the recommended level of 9.3. Use ammonium hydroxide to raise the pH or ammonium bicarbonate to lower the pH.

   DANGER! AMMONIUM HYDROXIDE IS CORROSIVE AND CAN CAUSE SEVERE BURNS TO BOTH SKIN AND EYES. AVOID BREATHING ANY FUMES BY USING ADEQUATE VENTILATION AND/OR APPROVED

RESPIRATORY EQUIPMENT. AVOID CONTACT WITH EYES AND SKIN. WEAR FULL PROTECTIVE CLOTHING, FACE MASK, AND SAFETY GOGGLES. IN CASE OF CONTACT, FLUSH THE EXPOSED AREAS WITH CLEAN, COLD WATER. IN CASE OF INJURY, CONSULT A PHYSICIAN.

7. Bring the stripping solution to operating level, and to a temperature of 60 C (140 F).

CONTROL PROCEDURES

XPS-306B - XPS-307A

A constant stripping rate is maintained by making additions of 7.56 liters (two gallons) of XP-306B and 908 gm (two pounds) XPS-307A each time the dissolved nickel metal concentration increases 908 (two pounds). Without making periodic additions of XPS-306B and XPS-307A the life of the stripper is limited to 26 g/L (3.5 oz/gal) of dissolved nickel metal.

For further information on Control Procedures please refer to enclosed graphs.

No additions are to be made when there is work in the tank.

NOTE: XPS-306B must always be added before the XPS-307A, and in a ratio of 3.8 liters (1.0 gallon) XPS-306B to 0.45 kb (1.0 pound) XPS-307A. All additions must be dissolved prior to using the process.

pH

A pH above or below the recommended range may result in attack of the base metal, and a decrease in the stripping rate. The pH of the solution must be maintained at 9.0 to 9.5 and should be checked twice daily. Use ammonium hydroxide to raise the pH or ammonium bicarbonate to lower the pH.

DANGER! AMMONIUM HYDROXIDE IS CORROSIVE AND CAN CAUSE SEVERE BURNS TO BOTH SKIN AND EYES. AVOID BREATHING ANY FUMES BY USING ADEQUATE VENTILATION AND/OR APPROVED RESPIRATORY EQUIPMENT. AVOID CONTACT WITH EYES AND SKIN. WEAR FULL PROTECTIVE CLOTHING, FACE MASK, AND SAFETY GOGGLES. IN CASE OF CONTACT, FLUSH THE EXPOSED AREAS WITH CLEAN, COLD WATER. IN CASE OF INJURY, CONSULT A PHYSICIAN. USE ONLY CONCENTRATED AMMONIUM HYDROXIDE FOR PH ADJUSTMENTS. CAUSTIC SODA AND/OR CAUSTIC POTASH ARE NOT ACCEPTABLE AND SHOULD NEVER BE USED.

Temperature

Immersion Stripper XPS-306 is capable of stripping nickel at any temperature, however, temperatures below the recommended range will result in a substantial decrease in the stripping rate and may result in sludge formation on the work. This sludge can be eliminated by adjusting the solution to the optimum temperatures. Temperatures higher than the recommended range will result in an abrupt drop in the pH and increase the ammonium hydroxide consumption.

PROCESS CYCLE

Chrome Stripping and Activation Cycle

1. Chromium deposits must be completely stripped in anodic alkali solutions or 50% hydrochloric acid and water.

2. Rinse thoroughly.

3. Activate in fresh 50% hydrochloric acid and water. Severely passive nickel should be activated in cathodic UDYPREP 348 (16-32 oz/gal) at 6-9v.

4. Rinse THOROUGHLY. (NOTE: Chloride and fluoride ions may cause contamination.)

5. Strip.

Replate Cleaning

During normal stripping, a black film forms which sluffs off upon completion of the operation. This black film may stick to the parts and may require an extra cleaning cycle.

1. Cold water spray rinse (remove loose film).

2. Anodic clean - 1 minute.

3. Cold water spray rinse.

4. Hyrdochloric Acid (50%) dip - 15 to 30 seconds.

5. Cold water spray rinse.

Follow with normal cleaning cycle.

SLUDGE REMOVAL

Sludge removal will be necessary before the accumulated sludge reaches the bottom of the racks. Allow the sludge to cool and settle overnight (8-10 hours). Decant the solution into a clean lined holding tank. Remove the sludge by shoveling into lined drums or other suitable containers. The sludge contains metal salts, which can be reclaimed.

CAUTION: CONTACT WITH SLUDGE CONTAINING METAL SALTS CAN CAUSE EYE AND/OR SKIN IRRITATION. USE CHEMICAL GOGGLES, IMPERVIOUS GLOVES/BOOTS AND PROTECTIVE CLOTHING WHEN HANDLING OR WORKING NEAR THESE SLUDGES. IN THE EVENT OF SKIN OR EYE CONTACT, WASH IMMEDIATELY WITH CLEAN WATER.

Replenishment of additives are required after the desludging procedure. For every 3.78 L (1 gallon) of solution removed, add 1.89 L (0.5 gallon) of XPS-306B and .226 kg (0.5 lb.) of XPS-307A. Adjust to final operating volume with water and adjust the pH to recommended range with ammonium hydroxide.

WARNING! XPS-306B IS AN ALKALINE SOLUTION (pH 9.0-9.2). XPS-307A IS A STRONG OXIDIZING AGENT. WEAR PROTECTIVE CLOTHING, FACIAL MASK AND CHEMICAL SAFETY GOGGLES. FLUSH EXPOSED AREAS WITH LARGE QUANTITIES OF CLEAN WATER. WASH SKIN WITH SOAP AND WATER. IN CASE OF INJURY, CONSULT A PHYSICIAN.

DANGER! AMMONIUM HYDROXIDE IS CORROSIVE AND WILL CAUSE SEVERE BURNS TO BOTH SKIN AND EYES. AVOID BREATHING ANY FUMES BY USING ADEQUATE VENTILATION AND/OR APPROVED RESPIRATORY EQUIPMENT. AVOID CONTACT WITH EYES AND SKIN. WEAR FULL PROTECTIVE CLOTHING, SAFETY GOGGLES AND FACE MASK. IN CASE OF CONTACT, FLUSH THE EXPOSED AREAS WITH CLEAN, COLD WATER. IN CASE OF INJURY, CONSULT A PHYSICIAN.

WASTE TREATMENT

Rinses following the stripping operation must be chlorinated to remove the ammonium ions. After the removal of the ammonium ions, the pH must be raised to 8.5 to precipitate the heavy metal salts. Addition of a flocculating agents will assist in coagulating the precipitated metal salts. Disposal of the metal salts may now be accomplished in accordance with applicable regulatory statues.

In all cases, consult with pertinent waste treatment authorities for specific restriction in your area.

UDYLITE: XPS -306B IMMERSION STRIPPER
Proprietary Formulation

Hazardous Components — Section II

	CAS No.	Percentage	TLV OSHA ACGIH
None			

Physical Data — Section III

Appearance and Odor: Colorless liquid with ammonia odor.

Solubility in Water:			
Negligible	<0.1%	Boiling Point	NA
Slight	0.1-1.0%	Vapor Pressure	NA
Moderate	1.0-10.0	% Volatile by Volume	NA
Appreciable	>10.0%	Evaporation Rate	NA
Complete (all proportion)	x	Specific Gravity	1.071
		pH	9.0 - 9.2

Fire and Explosion Hazard Data — Section IV

Flash Point (method used) None — Flammable/Explosive Limits LEL N/A UEL N/A

NFPA Code (0-4) — Health 0 Flammability 0 Reactivity 0

Extinguishing Media: Product will not burn.
Special Fire-Fighting Procedures: Use media suitable for surrounding fire.
Unusual Fire and Explosion Hazards: Thermal decomposition may yield ammonia fumes.

Health Hazard Data — Section V

Threshold Limit Value: None known or established.
Effects of Overexposure:
- Acute: Possible eye and skin irritant.
- Chronic: None expected.
- Principal Exposure: Contact.

Emergency First Aid Procedures:
- Eye: Flush with a directed stream of water for 15 minutes. Seek medical attention.
- Skin: Wash with soap and water.
- Inhalation: Remove to fresh air.
- Swallowing: Drink water (2-3 glasses) to dilute. Seek medical attention.

Reactivity Data — Section VI

Stability: Stable x Unstable

Incompatibility (Materials to Avoid): Oxidizers, strong acids.
Hazardous Decomposition Products: None
Hazardous Polymerization: May Occur Will Not Occur x

Spill or Leak Procedures Section VII

Steps to be taken in case material is released or spilled:
Contain and place into a container suitable for transportation to licensed waste treatment facility.

Waste Disposal Method Licensed waste treatment facility.
EPA I.D. Number N/A RQ N/A

Special Protection Information Section VIII

Ventilation:
Local Exhaust Yes Respiratory Protection No
Protective Clothing:
Gloves: butyl rubber or neoprene Boots: No
Chem. Safety Goggles: Yes Other: No
Full Face Shield No

NOTE: Eye Fountain and Safety Shower must always be available.

Special Precautions Section IX

Handling & Storage: Store away from oxidizers, strong acids.
Other: None

Shipping Information Section X

DOT Proper Shipping Name:		None		
Hazard Class:		None		
DOT Label(s)		None		
IATA	Class:	N/A	Packing Group	N/A
IMDGC	Class:	N/A	Packing Group	N/A

Prepared by Carl Gilsdorf, Manager, Quality Assurance - 4/18/86

This form has been prepared and reviewed by technically knowledgeable people and is based on information OMI International Corporation believes to be reliable. This information is provided solely to provide health and safety guidelines and is not to be intended to any other purpose.

UDYLITE XPS-307A STRIPPER

Proprietary Formulation

SECTION II - HAZARDOUS COMPONENTS

Hazardous Components	Cas No.	%	TLV OSHA ACGIH
-N O N E-			

SECTION III - PHYSICAL DATA

Appearance and Odor: Cream-to-yellow solid with mild odor.

Solubility in Water:				
			Boiling Point	NA
Negligible	<0.1%	---	Vapor Pressure	NA
Slight	0.1-1.0%	---	Percent Volatile by Vol.	NA
Moderate	1.0-10.0%	X	Evaporation Rate	NA
Appreciable	>10.0%	---	Specific Gravity	3.7
Complete(all proportions)		---	pH of 10% sol'n.	9.7

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: None Flammable/Explosive Limits LEL N/A UEL N/A
(method used)

NFPA Code (0-4) Health - 0 Flammability - 0 Reactivity - 0

Extinguishing Media:

Product will not burn.

Special Fire Fighting Procedures:

Use media suitable for surrounding fire.

Unusual Fire and Explosion Hazards:

Thermal decomposition may yield oxides of sulfur and nitrogen.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value: None known or established.

Effect of Overexposure:

Acute: Possible eye and skin irritant.

Chronic: None expected.

Principal Route of Exposure: Contact

Emergency First Aid Procedures:

Eye:	Flush with a directed stream of water for 15 minutes. Seek medical attention.
Skin:	Wash with soap and water.
Inhalation:	Remove to fresh air.
Swallowing:	Drink water (2-3 glasses) to dilute. Seek medical attention.

SECTION VI - REACTIVITY DATA

Stability: Stable

Incompatibility:
(Materials to Avoid: Reducing agents, organics, flammables/combustibles, sodium hydroxide.

Hazardous Decomposition Products: None

Hazardous Polymerization: Will not occur.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in case material is released or spilled:

Contain and place into a container suitable for transportation to a licensed wasted treatment facility.

Waste Disposal Method:

Licensed waste treatment facility.

EPA I. D. Number: NA RQ NA

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation:

Local Exhaust: Yes Respiratory Protection: NIOSH Dust Mask

Protective Clothing:

Gloves:	butyl rubber or neoprene	Boots:	No
Chemical Goggles	Yes	Other:	No
Full Face Shield	No		

NOTE: Eye Fountain and Safety Shower must always be available.

SECTION IX - SPECIAL PRECAUTIONS

Handling and Storage:

Store away from incompatibles in Section VI and heat sources.

Other:

None

SECTION X - SHIPPING INFORMATION

DOT Proper Shipping Name:		None		
Hazard Class:		None		
DOT Label(s):		None		
IATA	Class:	NA	Packing Group:	NA
IMDGC	Class:	NA	Packing Group:	NA

PATSTRIP Ni

INTRODUCTION:

Patstrip Ni was specifically developed for the stripping of nickel from copper and copper bearing alloys without attacking base metal.

OPERATING PROCEDURES:

Concentration:	1 lb. of Patstrip Ni per gal. of a 10% sulphuric acid solution.
Temperature:	Room.
Tank:	Lead, koroseal rubber, polyethylene or PVC lined.
Racks and Baskets:	Plastisol covered metal.

After immersion in Patstrip Ni the work will turn black and the work is then rinsed in a dilute cyanide rinse to remove the smut and to make sure that all the nickel is removed from the base metal. The black smut can also be removed in Muriatic Acid or diluted to 50% concentration. However, the cyanide solution leaves the metal with a brighter finish.

PATSTRIP Ni-2

SECTION II - HAZARDOUS INGREDIENTS

Not Applicable

Hazardous Mixtures of Other Liquids, Solids or Gases

Sodium Metanitrobenzenesulfonate	Cas #127-64-4
Ammonium Thiocyante	Cas #1764-95-4

SECTION III - PHYSICAL DATA

Boiling Point: NA	Specific Gravity: NA
Vapor Pressure: NA	% Volatile by Vol: NA
Vapor Density: NA	Evaporation Rate: NA
Solubility in Water: 20 C 310 g/l	

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point (method used): 200 Abel Pensky

Extinguishing Media:

Water fog, foam and dry chemical

Special Fire Fighting Procedures:

Fire fighters should be equipped with air supplied respirators.

Unusual Fire and Explosion Hazards:

Dust explosion should be considered.

SECTION V - HEALTH HAZARD DATA

Effects of Overexposure:

Avoid contact with eyes, skin, mucous membranes. Wash thoroughly after handling.

Emergency and First Aid Procedures:

In case of contact, flush eyes with running water for 15 minutes. If irritation persists, consult a physician.

SECTION VI - REACTIVITY DATA

Stability: Unstable

Conditions to Avoid: Temperature over 370 C, hot (up to 379). Axle bearings in mixing plants.

Incompatibility:

Caustic soda or oxidizable mixtures should not be heated.

Hazardous Decomposition Products:

NA

Hazardous Polymerization: Will not occur.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps To be Taken in Case Material is Released or Spilled:

Flush to sewer with much water.

Waste Disposal Method:

Solutions may require neutralization with soda ash and HCl if disposed to sewer. Can be incinerated.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Respiratory Protection:

Dust Mask as necessary

Ventilation:

Local Exhaust: For pouring or mixing operation

Protective Clothing:

Gloves: Rubber gloves, aprons, as necessary

Eyes: Goggles/side shield/safety glasses

SECTION IX - SPECIAL PRECAUTIONS

Precautions To Be Taken in Handling and Storing:

Store in a cool dry place away from reducing agents

PATSTRIP Ni-E

PATSTRIP Ni-E

Electrolytic, Non Cyanide Stripper for Stripping Nickel and other Metals from Steel.

INTRODUCTION:

Patstrip Ni-E was developed to eliminate the use of cyanide and short-lived compounds for stripping nickel from steel. Not only does Patstrip Ni-E strip nickel, but it will also strip copper, chrome, zinc, cadmium and Electroless Nickel, as well. Patstrip Ni-E is used with reverse current. It is long-lived and it does not fume when used.

OPERATING CONDITIONS:

Concentration:	3 - 4 lb. per gal. of water.
Operating pH:	Optimum pH 5-7. When the pH rises above 8 bring down the pH of the bath by small additions of nitric acid.
Tank:	Steel and steel cathodes. If possible, use with air agitation.
Temperature:	Room. Do not allow Patstrip Ni-E solution to get above 100 F. When hot it has a tendency to pit the steel.
Current Density:	6 - 9 volts, 100 amps per square foot minimum.
Current:	Reverse.
Time:	Depending upon the amount of metal to be stripped.
Rack:	Use mild steel or titanium. DO NOT USE STAINLESS OR COPPER ALLOY TIPS.

MAINTAINING LIFE OF BATH: Keep the pH between 5 and 8. When sludge has build up on the bottom of the tank allow it to settle. decant or syphon off supernatant liquid and remove the sludge. Replace the supernatant liquid in tank adding fresh water and fresh Patstrip Ni-E. Resume stripping.

PATSTRIP NI-E

SECTION II - HAZARDOUS INGREDIENTS

Hazardous Mixtures of Other Liquids, Solids or Gases

Sodium Nitrate - CAS #7631-99-4

SECTION III - PHYSICAL DATA

Boiling Point	NA	Specific Gravity	NA
Vapor Pressure	NA	% Volative by volume	NA
Vapor Density	NA	Evaporation Rate	NA
Solubility in H2O	Completely		

Appearance and Odor - Blue - No odor

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Distinguishing Media: Use large quantities of water in fighting fires.

Special Fire Fighting Procedures: Will supply oxygen to a fire thus suffocating type extinguishers are of little value.

Unusual Fire and Explosion Hazards: Oxidizing material in contact with easily oxidizable substance may react readily to ignition, violent combustion or explosion. Increases flammability or a combustible substance.

SECTION V - HEALTH HAZARD DATA

EFFECTS OF OVEREXPOSURE: Prolonged inhalation of dust may cause irritation. Concentrated solution can cause severe local irritation.

EMERGENCY AND FIRST AID PROCEDURES: Wash immediately with water and soap.

SECTION VI - REACTIVITY DATA

Stability Unstable x Stable

Conditions to Avoid: Contamination with combustibles or reducing agents

Incompatibility (Materials to avoid): Combustibles and reducing agents.

Hazardous Decomposition Products: Oxygen and nitrogen oxides when heated.

Hazardous Polymerization: Will not occur.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in case material is released or spilled: Do not allow spills to remain in contact with combustibles. Spills may be washed away with water or shovel into clean empty drum; closed marked "Oxidizer."

Waste Disposal Method: Waste disposal must comply with Federal, State and Local Disposal Laws.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Respiratory Protection: NA

Ventilation: Local Exhaust - To remove any gases evolved during electrolysis.
Mechanical - NA

Protective Gloves: Rubber or neoprene

Eye Protection: Protective goggles

Other Protective Equipment: NA

SECTION IX - SPECIAL PRECAUTIONS

Precautions to be taken in handling and storing: Store away from combustibles or reducing agents in a cool dry place. Avoid storage on wooden floors.

Other precautions: NA

Prepared by Rubin M. Operowsky.

DIP N STRIP III

SECTION II - HAZARDOUS INGREDIENTS

Not Applicable

Hazardous Mixtures of Other Liquids,Solids or Gases

Contains: ETHYLENEDIAMINE CAS #107-15-3

SECTION III - PHYSICAL DATA

Boiling Point	112-117 F
Vapor Pressure	6 mm Hg
Vapor Density	75
Solubility in Water	Complete
Appearance and Odor	Clear-ammonial odor

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point - Not Applicable   Flammable Limits - Not Applicable

Extinguishing
Media: Water Fog Alcohol Foam CO2 Dry Chemical

Special Fire Fighting Procedures: Use full protective clothing and a positive pressure breathing apparatus.

Unusual Fire and Explosion Hazards: NA

SECTION V - HEALTH HAZARD DATA

Effects of Overexposure: Disagreeable and painful irritation of eyes, nose, throat and lungs. Allergic response - severe burns.

Emergency and First Aid Procedures: Immediate & continuous irrigation with flowing water AT LEAST 30 MINUTES IMPERATIVE. See a doctor immediately.

SECTION VI - REACTIVITY DATA

Materials to Avoid: Acid Oxidizing Material: Halogenated Organic Compounds, Nitrogen Oxide when burned.

Hazardous Polymerization: Will not occur.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps To Be Taken in Case Material is Released or Spilled:
Large spill: Dike up and dilute with copious quantities of water-pump into appropriate container.
Small spill: Dilute with water.

Waste Disposal Method: Large quantities can be recovered otherwise dispose in landfill in accordance with local regulations. Keep out of public water supplies.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Respiratory Protection (Specify Type): Approved organic vapor type respirator required in absence of proper ventilation.

Ventilation:	Local Exhaust:	Exhaust Fans
	Mechanical:	Control of vapors to suggested guide.

Protective Gloves: Rubber   Eye Protection: Protective Goggles

Other Protective Equipment: Aprons & Protective Clothing

SECTION IX - SPECIAL PRECAUTIONS

Precautions To Be Taken in Handling and Storing: Store away from copper or copper bearing allows. Store below at 120 F in cool dry place.

Special Precautions: N/A

DIP N. STRIP III

INTRODUCTION:

DIP N. STRIP was specifically formulated for the stripping of nickel, electroless nickel, copper, without cyanide, from steel without attack to the base metal. DIP N. STRIP is relatively long-lived.

PROCEDURE:

Concentration:	1 part DIP N. STRIP/9 parts water 6-8 oz. Patstrip Ni-2/gal of water.
Temperature:	160 F.
Equipment:	DIP N. STRIP is used in a mild steel tank with agitation. If the pieces are small, they can be stripped by tumbling in a plating barrel.

MAINTENANCE OF SOLUTION:	When the stripping time has slowed down, a replenishment of 1/4 of the original concentration of DIP N. STRIP/1 gal. solution of stripper is added. 2 or 3 additions can be made before the bath is ready for disposal.

AFTER TREATMENT: A dark deposit is left after stripping which can readily be removed by a dip in a solution of 4 oz./1 gal. water of sodium cyanide.

PATSTRIP NiX -85

INTRODUCTION: #NiX-85 is a non cyanide, alkaline stripping process that was specifically developed to remove nickel plate from steel, copper alloys and copper by immersion. Depending on the temperature of the stripping solution, a new NiX-85 solution will strip at the rate of .25 to 1.00 mil. of nickel metal per hour. One gallon of #NiX-85 will dissolve approximately 2-4 oz. of nickel metal.

OPERATING CONDITIONS:

Concentration:	25% by volume of Patstrip #72Y. 20% by volume of Patstrip #73W.
Optimum Stripping Temperature:	175 F
Time:	Depending upon thickness of coating and temperature of bath.
Make-Up of 100 gal. Bath:	25 gal. Patstrip #72Y 20 gal. Patstrip #73W 55 gal. Water

EQUIPMENT:

Tanks should be constructed of steel or stainless steel.

Heating coils should be of mild steel or stainless steel. Teflon heating coils also may be used.

AGITATION:

Mechanical agitation is recommended to avoid local overheating. Agitators should be made of steel or stainless steel or plastol coated. DO NOT USE AIR AGITATION.

The stripping tank should be kept covered at all times to prevent evaporation of one of the components. When not in use, the stripping solution should not be kept hot for any extended length of time. Covers can be made of steel, stainless steel, polyethylene of PVC.

#NiX-85 solution should be used in a well ventilated area. Exhaust ventilation should be used.

APPLICATION:

All grease and organic contamination should be removed prior to stripping. All brass and chromium should be removed prior to stripping. The chromium can be removed by immersion in hydrochloric acid. Both the Brass and Chromium can also be stripped using a strong reverse alkaline electrocleaner; in which case the parts should then be immersed in a 50% hydrochloric acid solution to activate the nickel, followed by an overflow water rinse before immersion in the #NiX-85 solution.

CAUTION........

Do not contaminate #NiX-85 solution with salts of chromium, copper, lead and cadmium or the above metals. Metallic and organic contamination will shorten the life of the stripper.

Avoid contact with parts to be stripped with the sides of the tank or any of the heating or temperature control equipment or agitator. The equipment should be insulated to prevent any stray currents from setting up a galvanic cell within the stripping solution.

In the stripping of nickel from copper and its alloys, an inhibiting film will cover the copper parts. This film can be removed either in a dilute sodium cyanide solution or chromic acid solution or in a solution of Patclin #977 which is neither chromated or contains cyanide.

#NiX-85 is a balanced bath and unless it is overheated and used without a cover, the solution will be exhausted uniformly. We do not recommend the replenishment of spent solution to be economical. We believe the solution should be discarded.

#NiX-85 contains amines and may cause skin irritation. The components of NiX-85, Patstrip 72Y and Patstrip 73W, as well as the NiX-85 operating solution should be handled with care. Proper protective gloves and eye glasses should be used to prevent skin and eye contact. Do not inhale the vapors from the original bath or its operating solution.

PATCLIN #73-W

SECTION II - HAZARDOUS INGREDIENTS

Components	CAS No.	OSHA	ACGIH TLV
Nitrodracylic Acid	62-23-7	Not Est.	Not Est.
Ethylenediamine	107-15-3	10 ppm	10 ppm

SECTION III - PHYSICAL CHARACTERISTICS

Boiling Point: 214 F   Specific Gravity: 1.064

Vapor Pressure: NA   Melting Point: NA

Vapor Density: NA   Evaporation Rate: NA

Solubility in Water: Completely

Appearance and Odor: Clear ammoniacal

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: NA

Exstinguishing Media: Water spray, foam, carbon dioxide, dry chemical.

Special Fire Fighting Procedures: Use full protective clothing and a positive breathing apparatus.

Unusual Fire and Explosion Hazards: Do not use material containing halogenated hydrocarbon as extinguishing media.

SECTION V - REACTIVITY DATA

Stability: Stable   Conditions to Avoid: None

Incompatibility: Avoid contamination with mineral or organic acids, oxidizing materials, adlehydes, ketones and organic halides.

Hazardous Decomposition: Burning can produce carbon monoxide and/or carbon dioxide and oxides of nitrogen.

Hazardous Polymerization: Will not occur.

SECTION VI - HEALTH HAZARD DATA

Health Hazards (Acute & Chronic):

Health - 0   Reactivity - 0

Flammability - 0   Protective Equipment - 0

Signs & Symptoms of Exposure:

Swallowing: Moderately toxic. May cause burns of mouth and throat. Abdominal pain, nausea, vomiting, diarrhea.

Skin Absorption: Prolonged or repeated exposure may result in the absorption of harmful amounts of material.

Inhalation: Vapors are irritating and may cause nausea, vomiting, and sensitization of the respiratory tract.

Skin Contact: Causes chemical burns and may result in the development of allergic skin reaction.

Eye Contact: Causes moderate corneal injury. Vapor may cause temporary disturbance of vision.

Emergency First Aid Procedures:

Swallowing: Do not induce vomiting. Give large quantities of water to dilute material; call a physician.

Skin: Remove contaminated clothing and flush skin with plenty of water. Call a physician.

Inhalation: Remove to fresh air. If breathing is difficult, oxygen may be given. Call a physician.

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention-preferably an opthalmologist promptly.

Steps To Be Taken in Case Material is Released or Spilled: Wear suitable protective equipment; avoid contact with liquid and vapors! Small spills could be flushed with large amounts of water. Larger spills should be collected for disposal. Avoid discharge to sewers or waterways. At about 500 ppm concentration or higher it can be toxic to the biomass in a treatment system. Also, it is toxic to fish. Incineration is the preferred method of disposal.

Waste Disposal Method: Incinerate in a furnace where permitted under appropriate Federal, State and local regulations.

Precautions to Be Taken in Handling and Storing: Do not get in eyes, on skin, on clothing. Avoid breathing vapor. Keep away from heat and flame. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling.

SECTION VIII - CONTROL MEASURES

Respiratory Protection: Self contained breathing apparatus in high vapor concentration.

Ventilation: Local Exhaust needed at points where vapors can be expected to escape to workplace.
Mechanical: Should be satisfactory.

Protective Gloves: Butyl

Eye Protection: Monogoggles

Other Protective Equipment: Eye bath, safety shower and chemical apron.

PATSTRIP #72-Y

SECTION II - HAZARDOUS INGREDIENTS

Components	Cas No.	OSHA	ACGOJ TLV
Ethylenediamine	107-15-3	10 ppm	10 ppm

SECTION III - PHYSICAL CHARACTERISTICS

Boiling Point: NA
Specific Gravity: 1.075
Vapor Pressure: NA
Melting Point: NA
Vapor Density: NA
Evaporation Rate: NA
Solubility in Water: Complete
Appearance and Odor: Clear-ammoniacal

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: NA
Flammable Limits: NA
Extinguishing Media: Apply alcohol-type or all-purpose foams by manufacturer's recommended techniques for large fires. Use CO2 or dry chemical media for small fires.

Special Fire Fighting Procedures: Do not spray pool fires directly; a solid stream of water directed into hot burning liquid can cause splattering. Use self-contained breathing apparatus and protective closing; oxides of nitrogen will be evolved.

Unusual Fire and Explosion Hazards: May produce a floating fire hazard and extreme fire condition.

SECTION V - REACTIVITY DATA

Stability: Stable Conditions to Avoid: None

Incompatibility: Avoid contamination with mineral or organic acids, oxidizing materials, adlehydes, ketones and organic halides.

Hazardous Decomposition: Burning can produce carbon monoxide and/or carbon dioxide and oxides of nitrogen.

Hazardous Polymerization: Will not occur.

SECTION VI - HEALTH HAZARD DATA

Health Hazards (Acute and Chronic):

Health - 0 Reactivity - 0

Flammability - 0 Protective Equipment - 0

Signs and Symptoms of Exposure:

Swallowing: Moderately toxic. May cause burns of mouth and throat. Abdominal pain, nausea, vomiting, diarrhea.

Skin Absorption: Prolonged or repeated exposure may result in the absorption of harmful amounts of material.

Inhalation: Vapors are irritating and may cause nausea, vomiting and sensitization of the respiratory tract.

Skin Contact: Causes chemical burns and may result in the development of allergic skin reactions.

Eye Contact: Causes moderate corneal injury. Vapor may cause temporary disturbance of vision.

Emergency First Aid Procedures:

Swallowing: Do not induce vomiting. Give large quantities of water to dilute material. Call a physician.

Skin: Remove contaminated clothing and flush skin with plenty of water. Call a physician.

Inhalation: Remove to fresh air. If breathing is difficult oxygen can be given. Call a physician.

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention, preferably an opthomologist promptly.

Steps To Be Taken in Case Material is Released or Spilled: Wear suitable protective equipment; avoid contact with liquid and vapors! Small spills could be flushed with large amounts of water. Larger spills should be collected for disposal. Avoid discharge to sewers or waterways. At about 500 ppm concentration or higher it can be toxic to the biomass in a treatment system. Also, it is toxic to fish. Incineration is the preferred method disposal.

Waste Disposal Method: Incinerate in a furnace where permitted under appropriate Federal, State and local regulations.

Precautions to Be Taken in Handling and Storing: Do not get in eyes, on skin, on clothing. Avoid breathing vapor. Keep away from heat and flame. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling.

SECTION VIII - CONTROL MEASURES

Respiratory Protection: Self contained breathing apparatus in high vapor concentration.

Ventilation: Local Exhaust: needed at points where vapors can be expected to escape to workplace.
Mechanical: should be satisfactory.

Protective Gloves: Butyl   Eye Protection: Monogoggles

Other Protective Equipment: Eye bath, safety shower and chemical apron.

NICKEL STRIPPER 424 D

SECTION I - HAZARDOUS COMPONENTS

Component	Cas No.	Weight Percent	ACGIH TLV ppm(mg/m3	Carcinogen Status
Thiourea	62-56-6	2	NA	listed by NTP, IARC
m-nitrobenzenesulfonic acid, sodium salt	127-68-4	60	NA	NA
Nitrolotriacetic acid, trisodium salt monohydrate (NTA)	5064-31-3	23	NA	listed by NTP
Proprietary ingredients,		15		

not deemed hazardous per OSHA Hazard Communication Standard.

SECTION II - PHYSICAL DATA

Boiling Point:	N.A.	Specific Gravity:	N.A.
Vapor Pressure: (mmHg)	N.A.	Solubility in Water:	Appreciable
% Volatile by Vol:	N.A.		
Evaporation Rate:	N.A.		
Vapor Density (Air=1):	N.A.	pH:	N.A.

Appearance and Odor: Light yellow powder with a slight non-irritating odor.

SECTION III - PHYSICAL HAZARDS

DOT PROPER SHIPPING NAME: Not Regulated

DOT HAZARD CLASSIFICATION: Not Regulated

DOT HAZARD IDENTIFICATION NUMBER: Not Regulated

FIRE AND EXPLOSION HAZARD DATA

Flash Point: Non-flammable Method Used: N.A.

Extinguishing Media: Water, Carbon dioxide, dry chemicals

Special Fire Fighting Procedures: Check for presence of toxic sulfur oxide fumes. Use self contained breathing apparatus and full protective clothing.

Unusual Fire and Explosion Hazards: If heated to decomposition, toxic sulfur oxide fumes may be emitted.

REACTIVITY DATA

Stability: Stable
Conditions to Avoid: Do not store near oxidizing agents.

Incompatibility: Oxidizing agents

Decomposition Products: If heated to decomposition, toxic sulfur oxide fumes may be emitted.

Hazardous Polymerization: Will not occur

SECTION V - HEALTH HAZARDS

Exposure Limits: Not established. Avoid contact with material. Avoid exposure to dusts, mists or vapors.

Routes of Entry: Inhalation, ingestion, eye and skin contact.

Acute Effects: Contact with eyes, skin or mucous membranes may cause irritation. Inhalation of dusts or mist may result in coughing and irritation of respiratory tract. Ingestion may cause moderate to severe toxicity.

Chronic Effects: Repeated or prolonged contact with skin may cause drying and irritation. Prolonged, repeated skin contact may cause eczema or rash.

NOTE: Thiourea and NTA have been shown to cause cancer in laboratory animals.

FIRST AID PROCEDURES:

Ingestion: Contact physician immediately.

Eye Contact: Flush with water immediately for at least 15 minutes, then contact a physician.

Skin Contact: Flush skin with plenty of water. Contact a physician if irritation persists.

Inhalation: Move to fresh air.

SECTION VI - SPILL, LEAK AND DISPOSAL PROCEDURES

Action to Take for Spills: Spills may be scooped up carefully and placed in container for disposal. Flush area with cold water into waste treatment system.

Disposal Method: Dispose of in accordance with all federal, state and local regulations. Contact Shipley Technical Service Representative if further assistance is needed.

SECTION VII - PRECAUTIONS FOR SAFE USE AND HANDLING

Ventilation: Provide adequate general or local exhaust ventilation to control dusts, mists or vapors below the recommended exposure limits.

Respiratory Protection: None normally required when adequate exhaust ventilation is provided. In situations where dusts, mists or vapors may accumulate, use a NIOSH/MSHA approved respirator.

Eye Protection: Chemical goggles.

Protective Clothing: Rubber gloves and suitable protective clothing to prevent skin contact.

Work Practices: Avoid skin contact. Practice good personal hygiene to prevent accidental exposure.

SECTION VIII - SPECIAL PRECAUTIONS AND ADDITIONAL INFORMATION

Precautions to be Taken in Handling and Storing: WARNING! Treat as a mixture containing thiourea and NTA. Store in closed original container in a cool, dry area at 50 to 90 F. Store away from strong oxidants. Do not store in direct sunlight. Keep container closed when not in use.

NICKEL STRIPPER 424 L

SECTION I - HAZARDOUS COMPONENTS

Component	Cas. No.	Weight %	ACGIH TLV ppm(mg/m3)	Carcinogen Status
Nitrolotriacetic acid trisodium salt mono-hydrate (NTA)	5064-31-3	15	NA	listed by NTP
Ethylenediamine	107-15-3	1	10(25)	NA
Proprietary blend of short chain aliphatic amine compounds*		24	NA	NA
Other proprietary ingredients, including water, not deemed hazardous per OSHA Hazard Communication Standard.		60		

*Identity withheld as Trade Secret

SECTION II - PHYSICAL DATA

Boiling Point: > 212 F
Specific Gravity: Approx. 1.3
Vapor Pressure (mmHg): NA
Solubility in Water: Complete
% Volatile by Vol.: NA
Evaporation Rate: NA
Vapor Density (Air=1): NA
pH: greater than 12
Appearance and Odor: Yellow liquid with a slight ammonia odor.

SECTION III - PHYSICAL HAZARDS

DOT PROPER SHIPPING NAME: Alkaline Liquid, N. O. S.
DOT HAZARD CLASSIFICATION: Corrosive Material
DOT HAZARD IDENTIFICATION NUMBER: NA1719

FIRE AND EXPLOSION HAZARD DATA

Flash Point: Non-flammable
Method Used: NA
Extinguishing Media: Water, Carbon Dioxide, dry chemicals
Special Fire Fighting Procedures: NA
Unusual Fire and Explosion Hazards: NA

REACTIVITY DATA

Stability: Stable

Conditions to Avoid: Do not store near acids, oxidizing agents.

Incompatibility: Acids, oxidizing agents

Decomposition Products: When heated to decomposition may emit toxic nitrogen oxides and carbon monoxide.

Hazardous Polymerization: Will not occur.

SECTION V - HEALTH HAZARDS

Exposure Limits: Not established. Avoid exposure to mists or vapors above component TLV's.

Routes of Entry: Inhalation of mist, ingestion, eye and skin contact.

Acute Effects: Contact with eyes may cause irritation or burns. Contact with skin and mucous membranes may cause irritation.

Chronic Effects: Prolonged or repeated skin contact may results in allergic sensitization or dermatitis.

NOTE: NTA has been shown to cause cancer in laboratory animals.

Emergency First Aid Procedures:

Ingestion: Contact physician immediately.

Eye Contact: Flush with water immediately for at least 15 minutes, then contact a physician.

Skin Contact: Flush skin with plenty of water. Contact a physician if irritation persists.

Inhalation: Move to fresh air.

SECTION VI - SPILL, LEAK AND DISPOSAL PROCEDURES

Action to Take for Spills: Spills may be absorbed with appropriate absorbent material for alkaline solutions and placed in container for disposal. Flush area with cold water into waste treatment system.

Disposal Method: Dispose of in accordance with all federal, state and local regulations. Contact Shipley Technical Service Representative if further assistance is needed.

SECTION VII - PRECAUTIONS FOR SAFE USE AND HANDLING

Ventilation: Provide adequate general or local exhaust ventilation.

Respiratory Protection: None normally required unless product is sprayed. In situations where mists or vapors may form (such as spraying), use a NIOSH/MSHA approved respirator.

Eye Protection: chemical goggles.

Protective Clothing: Chemical gloves and suitable protective clothing to prevent skin contact.

Work Practices: Avoid skin contact. Practice good personal hygiene to prevent accidental exposure.

SECTION VIII - SPECIAL PRECAUTIONS AND ADDITIONAL INFORMATION

Precautions to Be Taken in Handling and Storing: WARNING! Corrosive alkaline liquid. Store in a cool, dry area at 50-90 F. Keep away from acids, oxidizing agents. Do not store in direct sunlight. Keep container closed when not in use.

NIPOSIT 428 D NICKEL STRIPPER

SECTION I - HAZARDOUS COMPONENTS

Component	Cas No.	Weight Percent	ACGIH TLV ppm(mg/m3)	Carcinogen Status
Sodium-m-nitrobenzoate	827-95-2	95	NA	NA
Proprietary ingredients not deemed hazardous per OSHA Hazard Communication Standard		5		

SECTION II - PHYSICAL DATA

Boiling Point: NA
Vapor Pressure (mmHg): NA
% Volatile by Vol: NA
Evaporation Rate: NA
Vapor Density (Air=1) NA
Appearance & Odor: Off-white powder

Specific Gravity: NA
Solubility in Water: Appreciable
pH: NA

SECTION III - PHYSICAL HAZARDS

DOT Proper Shipping Name: Flammable Solid, N.O.S.
DOT Hazard Classification: Flammable Solid
DOT Hazard Identification Number: UN1325

Fire and Explosion Hazard Data

Flash Point: Method Used: NA

NA

Extinguishing Media: Water fog

Special Fire Fighting Procedures:

Wear full protective clothing and self contained breathing apparatus.

Unusual Fire and Explosion Hazards:

Grinding or mixing in the presents of dry alkali may cause autoignition. Upon decomposition, toxic nitrogen oxides may be emitted.

Reactivity Data

Stability:

Stable under normal conditions. Above 300 C material will burn and support combustion.

Conditions to Avoid:

Avoid high temperatures. Avoid grinding in presence of dry alkali (sodium or potassium hydroxide)--may cause auto-ignition.

Incompatibility:

Alkaline materials

Decomposition Products:

Upon decomposition toxic nitrogen oxides may be emitted.

Hazardous Polymerization:

Will not occur.

SECTION V - HEALTH HAZARDS

Exposure Limits:

Not established. Avoid exposure to dusts.

Routes of Entry:

Inhalation, ingestion, eye and skin contact.

Acute Effects:

Contact with eyes, skin or mucous membranes may cause irritation. Material is irritating to nasal passages and may cause sneezing.

Chronic Effects:

None known.

Emergency First Aid Procedures:

Ingestion:	Contact physician immediately.
Eye Contact:	Flush with water immediately for at least 15 minutes, then contact a physician.
Skin Contact:	Flush skin with plenty of water. Contact a physician if irritation persists.
Inhalation:	Move to fresh air.

SECTION VI - SPILL, LEAK AND DISPOSAL PROCEDURES

Action to Take for Spills:

Eliminate sources of ignition. Spills may be scooped up carefully and placed in container for disposal. Flush area with cold water into waste treatment system.

Disposal Method:

Dispose of in accordance with all federal, state and local regulations. Contact Shipley Technical Service Representative if further assistance is needed.

SECTION VII - PRECAUTIONS FOR SAFE USE AND HANDLING

Ventilation:

Provide adequate general or local exhaust ventilation.

Respiratory Protection:

None normally required if adequate exhaust ventilations is provided. In situations where dusts, mists, or vapors may form (such as spraying), use a NIOSH/MSHA approved respirator.

Eye Protection:

Chemical goggles.

Protective Clothing:

Chemical gloves and suitable protective clothing to prevent skin contact.

Work Practices:

Avoid skin contact. Avoid breathing dusts. Practice good personal hygiene to prevent accidental exposure.

SECTION VIII - SPECIAL PRECAUTIONS AND ADDITIONAL INFORMATION

Precautions to be taken in Handling and Storing:

WARNING! Flammable solid. Store in closed original container in a cool, dry area at 50-90 F. Keep away from alkaline materials. Keep away from excessive heat or open flames. Shower thoroughly after handling material. Do not store in direct sunlight. Keep container closed when not in use.

NIPOSIT 428 L NICKEL STRIPPER

SECTION I - HAZARDOUS COMPONENTS

Component	Cas. No.	Weight Percent	ACGIH TLV ppm(mg/m3	Carcinogen Status
Sodium hydroxide	1310-73-2	10	(2)	NA
Ethylenediamine	107-15-3	20	10(15)	NA
Ammonia	7664-41-7	6	25(18)	NA

Proprietary ingredients, 64
including water, not deemed hazardous per OSHA Hazard Communication Standard.

SECTION II - PHYSICAL DATA

Boiling Point:	> 212 F	Specific Gravity: App. 1.05	
Vapor Pressure (mmHg)	NA	Solubility in Water: Complete	
% Volatile by Volume	NA	pH: Greater than 12	
Evaporation Rate:	NA		
Vapor Density (Air=1)	NA		

Appearance and Odor: Clear liquid with an ammonia odor

SECTION III - PHYSICAL HAZARDS

DOT Proper Shipping Name: Alkaline Liquid, N.O.S.
DOT Hazard Classification: Corrosive Material
DOT Hazard Identification Number: NA 1719

Fire and Explosion Hazard Data

Flash Point: Non-flammable Method Used: NA

Extinguishing Media:

Water, carbon dioxide, dry chemicals

Special Fire Fighting Procedures:

Wear self contained breathing paratus and full protective clothing.

Unusual Fire and Explosion Hazards:

May emit toxic nitrogen oxides and carbon monoxide upon decomposition.

Reactivity Data

Stability: Stable

Conditions to Avoid: Do not store near acids, oxidizing agents.

Incompatibility: Acids, oxidizing agents

Decomposition Products: When heated to decomposition may emit toxic nitrogen oxides and carbon monoxide.

Hazardous Polymerization: Will not occur.

SECTION V - HEALTH HAZARDS

Exposure Limits:

Not established. Avoid exposure to mists or vapors above component TLV's.

Routes of Entry:

Inhalation of vapors or mist, ingestion, eye and skin contact.

Acute Effects:

Contact with eyes may cause severe burns. Contact with skin and mucous membranes may cause irritation or burns. Ingestion may cause severe gastrointestinal irritation.

Chronic Effects:

Prolonged, repeated inhalation or skin contact may result in allergic sensitization and dermatitis.

Emergency First Aid Procedures:

Ingestion: Contact physician immediately.

Eye Contact: Flush with water immediately for at least 15 minutes, then contact a physician.

Skin Contact: Flush skin with plenty of water. Contact a physician if irritation persists.

Inhalation: Move to fresh air.

SECTION VI - SPILL, LEAK AND DISPOSAL PROCEDURES

Action To Take for Spills:

If spilled eliminate sources if ignition, provide adequate ventilation and suitable protective clothing. Collect with appropriate absorbent material into suitable closed container for disposal. Transport to outside location. Flush area with cold water into waste treatment system.

Disposal Method:

Dispose of in accordance with all federal, state and local regulations. Contact Shipley Technical Service Representative if further assistant is needed.

SECTION VII - PRECAUTIONS FOR SAFE USE AND HANDLING

Ventilation:

Provide adequate general or local exhaust ventilation.

Respiratory Protection:

None normally required when adequate exhaust ventilation is provided. In situations where mists or vapors may form (such as spraying), use a NIOSH/MSHA approved respirator.

Eye Protection:

Chemical goggles

Protective Clothing:

Chemical gloves and suitable protective clothing to prevent skin contact.

Work Practices:

Avoid skin contact. Practice good personal hygiene to prevent accidental exposure.

SECTION VIII - SPECIAL PRECAUTIONS AND ADDITIONAL INFORMATION

Precautions to be Taken in Handling and Storing:

WARNING! Corrosive alkaline liquid. Store in a cool, dry area at 50-90 F. Keep away from acids, oxidizing agents. Do n.. store in direct sunlight. Keep container closed when not in use.

ARP-60

APPLICATION 1

INTRODUCTION:

ARP-60 is a versatile additive that can be used for two different stripping applications:

APPLICATION 1: When dissolved in water and mixed with sodium cyanide, ARP 60 becomes an alkaline immersion stripper that effectively removes copper, nickel, cadmium, zinc, silver and tin coatings from steel and other iron alloys.

APPLICATION 2: When dissolved in water and mixed with sulfuric acid, ARP 60 becomes an acid immersion stripper that effectively removes nickel and cadmium coatings from copper and brass.

CAUTION....
Contact of cyanide compounds or solutions with acids liberates poisonous gas. Since the APPLICATION 1 bath uses sodium cyanide and the APPLICATION 2 bath uses sulfuric acid, all plant operating personnel must be made aware of the potential hazard of either accidentally adding sulfuric acid to the APPLICATION 1 bath, or accidentally adding sodium cyanide to the APPLICATION 2 bath. This personnel awareness becomes even more important if stripping requirements mandate the operation of both types of baths at the same time.

To emphasize the need for separating one bath operation from the other, this technical bulletin is divided into two sections. Pages 1 and 2 contain only operating instructions and safety and handling information relating to the APPLICATION 1 bath. Pages 3 and 4 contain only operating instructions and safety and handling information relating to the APPLICATION 2 bath.

EQUIPMENT:

Use mild steel for tanks, heating coils and associated equipment. Do not use lead-lined tanks or lead heating coils. Do not use copper hooks or racks. Local ventilation equipment should be of adequate capacity to remove steam and gases when operating at elevated temperatures.

OPERATING DATA - APPLICATION 1

ARP 60 (initial makeup)	8 oz/gal (60g/L)
Sodium cyanide (initial makeup)	16-24 oz/gal (120-180g/L)
Free sodium cyanide (by analysis)	above 5 oz/gal (37.5g/L
Solution temperature	70-140F* (21-60C) 120F (49C) preferred

Solution pH	11.5-12.0
Stripping rate (at 120F; 49C)	
Nickel	0.5 mil (12.7um)/20 min.
Other metals	1 mil (25.4um)/20 min.

*Do not operate above 150F (66C) to avoid rapid decomposition of sodium cyanide.

SOLUTION MAKEUP AND MAINTENANCE:

CAUTION....ARP 60 powder and solution is an irritant to eyes, skin and respiratory tract. Sodium cyanide is highly toxic and may be fatal if swallowed or inhaled. Before using ARP 60 and/or sodium cyanide to made up or replenish the APPLICATION 1 working solution, refer to the Safety and Handling section on Page 2 to be certain you are aware of the protective gear you must wear, and the first-aid procedures to follow in the event of accidental exposure to the chemicals and to the working solution.

Solution Makeup:

1. Fill tank 2/3 full with water.
2. Add required amount of ARP 60 and stir thoroughly until dissolved.
3. Carefully add required amount of sodium cyanide and stir thoroughly until dissolved.
4. Add water to operating level and stir thoroughly.
5. Heat solution to operating temperature and stir.

Solution Maintenance:

A decrease in the stripping rate generally indicates a need for bath replenishment. A more precise indicator is the free sodium cyanide concentration, which is determined by titration analysis as described in the Analytical Control section. Maintain free sodium cyanide concentration above 5 oz/gal. (37.5g/L) by required additions of sodium cyanide and proportionate amounts of ARP 60 (see Table 1.) Adjust pH, if necessary, with small additions of sodium hydroxide. When the total weight of additions of ARP 60 reaches the weight of ARP 60 required for initial bath makeup, discard the old bath and make up a new bath.

TABLE 1

Pounds of Sodium Cyanide Added	Pounds of ARP 60 To be Added For Nickel	For Other Metals
1	0.66	0.33 to 0.5
2	1.33	0.66 to 1.0
5	3.33	1.66 to 2.5
10	6.6	3.33 to 5.0

ANALYTICAL CONTROL

Free Sodium Cyanide Analysis.
Reagents: 0.1N silver nitrate ($AgNO_3$)
10% potassium iodide sol. (KI)

Procedure:

1. Pipette 5 mL cooled sample of working solution into 250 mL Erlenmeyer flask.
2. Add 80 mL of cold distilled water.
3. Add 10 mL of 10% potassium iodide solution.
4. Titrate with 0.1N silver nitrate to first faint permanent turbidity.

CALCULATION:

oz free sodium cyanide/gal
= mL 0.1N silver nitrate x 0.262

g free sodium cyanide/L
= mL 0.1N silver nitrate x 1.97

STANDARD PACKAGES

ARP 60 - 120 pounds
200 pounds

SAFETY AND HANDLING

CAUTION...

ARP 60 powder is an irritant to eyes, skin and respiratory tract. Store in tightly closed containers away from heat and reactive chemicals. Avoid contact with eyes and skin. Do not swallow.

DANGER: Sodium cyanide, which is used in the makeup and replenishment of the Application 1 bath, is highly toxic and may be fatal if swallowed or inhaled. Do not get in eyes, on skin or on clothing. Store sodium cyanide in tightly closed containers segregated from acids and strong oxidizing materials such as

nitrates. Contact of cyanide compounds with acids liberates highly toxic and flammable gas. Never store, handle or consume food or beverages in areas where sodium cyanide is being used or stored.

PROTECTIVE EQUIPMENT: When using ARP 60 and sodium cyanide, wear rubber gloves, rubber apron, rubber boots, safety goggles and face shield, Wear an OSHA-approved dust mask while handling powders. Wash hands and gloves thoroughly after handling. Avoid inhaling mists, vapors or dust. NIOSH-approved escape respirator protection must be available. Cyanide containing solutions must be adequately ventilated.

FIRST AID (ARP 60): In case of eye or skin contact with ARP 60 or its solutions, immediately flush with large amounts of water for at least 15 minutes. Call a physician immediately. If powder is inhaled, remove victim to fresh air and call a physician.

FIRST AID (CYANIDE): In case of eye or skin contact with cyanide containing solutions, immediately flush with large amounts of water for at least 15 minutes. Call a physician immediately. In case of accidental ingestion, inhalation and/or skin absorption or cyanide or cyanide containing solutions, be prepared to administer cyanide poison antidote. Always have ready for immediate use at least 12 amyl nitrite pearls (a cyanide antidote kit is suggested). Start treatment and call a physician immediately. Carry victim to fresh air. Remove contaminated clothing. Keep victim warm.

If cyanide is inhaled: break an amyl nitrite pearl in a cloth and hold lightly under nose for 15 seconds. Repeat 5 times at about 15 second intervals. Repeat as necessary using a fresh amyl nitrite pearl every 3 minutes. Use artificial respiration if breathing has stopped.

If cyanide is swallowed: break an amyl nitrite pearl in a cloth and hold lightly under victim's nose for 15 seconds. If victim is conscious, or when consciousness returns, give an emetic, such as syrup of ipecac, to induce vomiting. (NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON). Repeat inhalation of amyl nitrite 5 times at about 15 second intervals. Repeat as necessary using a fresh amyl nitrite pearl every 3 minutes. Use artificial respiration if breathing has stopped.

SPILL OR LEAK: Wear protective equipment during cleanup of a spill or leak. Sweep up powder spill. Absorb liquid spill with an inert material such as sand, earth or vermiculite. Dispose of all residue consistent with federal, state and local regulations.

REQUIRED READING: ARP 60 is for industrial use only. Read Material Safety Data Sheet and product label before using. Also, follow supplier's safety recommendations for all other chemicals mentioned in this technical bulletin.

ARP 60

APPLICATION 2

INTRODUCTION:

ARP 60 is a versatile additive that can be used for two different stripping applications:

Application 1: When dissolved in water and mixed with sodium cyanide, ARP 60 becomes an alkaline immersion stripper that effectively removes copper, nickel, cadmium, zinc, silver and tine coatings from steel and other iron alloys.

Application 2: When dissolved in water and mixed with sulfuric acid, ARP 60 becomes an acid immersion stripper that effectively removes nickel and cadmium coatings from copper and brass.

CAUTION: Contact of cyanide compounds or solutions with acids liberates poisonous gas. Since the Application 1 bath uses sodium cyanide and Application 2 bath uses sulfuric acid, all plant operating personnel must be made aware of the potential hazard of either accidentally adding sulfuric acid to the Application 1 bath, or accidentally adding sodium cyanide to the Application 2 bath. This personnel awareness becomes even more important if stripping requirements mandate the operation of both types of baths at the same time.

To emphasize the need for separating one bath operation from the other, this technical bulletin is divided into two sections.

Pages 1 and 2 contain only operating instructions and safety and handling information relating to the Application 1 bath. Pages 3 and 4 contain only operating instructions and safety and handling information relating to the Application 2 bath.

Equipment

Tanks:
Mild steel tanks lined with PVC or equivalent may be used. Plastic tanks fabricated of acid-resistant materials also may be used.

Heating:
Quartz electric immersion heaters are satisfactory.

Agitation:
Agitation equipment should be of acid-resistant material. Mechanical agitation is preferred to air agitation.

Racks & Baskets:
Use plastisol-covered steel, brass, bronze or copper. When stripping bulk parts in basket, leave at least 4 to 5 inches (10-12.5 cm) clearance between basket bottom and tank bottom to prevent parts contact with sludge.

OPERATING DATA - APPLICATION 2

ARP 60	8-16 oz/gal (60-120 g/L)
Sulfuric acid (66 Baume')	3-10% by volume
Solution Temperature	140-170 F; 150 pref. (60-75C; 65C pref.)
Immersion time (at 150F; 65C)	15 min.-1 hour, depending on thickness of work

NOTE: To accelerate stripping time, use 1/2 oz./gal (3.75 g/L of sodium bisulfite. Use good ventilation.

SOLUTION MAKEUP AND MAINTENANCE:

CAUTION: ARP 60 powder is an irritant to eyes, skin and respiratory tract. Concentrated sulfuric acid is a very acidic material that can cause severe burns to eyes and skin. Before using ARP 60 and/or sulfuric acid to make up or replenish the Application 2 working solution, refer to Safety and Handling section on page 4 to be certain you are aware of the protective gear you must wear, the correct method of adding sulfuric acid to the working solution, and the first-aid procedures to follow in the event of accidental exposure to the chemicals and to the working solution.

SOLUTION MAKE-UP

1. Fill tank 2/3 fill with water.

2. Carefully add 3% by volume (of final volume) sulfuric acid (66 Be).

   CAUTION: To prevent excessive heat buildup and spattering add sulfuric acid slowly over entire surface of bath with constant agitation.

3. Heat acid-water mixture to 110 F (45C).

   NOTE: Do not use live steam to heat bath.

4. With agitation, carefully sprinkle required amount of ARP 60 powder over bath's surface. Stir thoroughly until dissolved.

5. Add water to operating level and mix thoroughly.

6. Heat solution to operating temperature.

SOLUTION MAINTENANCE:

Initially, the bath's stripping rate decreases slowly as the active ingredients are consumed. During this period, the bath may be "rejuvenated" (stripping rate increased) by adding sulfuric acid in increments of 3% by volume, up to a concentration of 10% by volume including the initial makeup addition. A rapid dropoff in stripping rate indicates that the bath is exhausted. At this point, the bath should be discarded and a fresh bath made up.

STANDARD PACKAGES

ARP 60	-	120 pounds
		200 pounds

SAFETY AND HANDLING:

CAUTION: ARP 60 powder is an irritant to eyes, skin and respiratory tract. Store in tightly closed containers away from heat and reactive chemicals. Avoid contact with eyes and skin. Do not swallow.

DANGER: Sulfuric acid, which is used in the makeup and replenishment of the Application 2 bath, is extremely corrosive and must be handled with care. Store in tightly closed containers away from direct heat and sunlight. Sulfuric acid may be fatal if swallowed or inhaled. Do not breathe vapors. Sulfuric acid can cause severe burns on contact with eyes and skin. Sulfuric acid reacts with water to produce heat. NEVER ADD WATER TO SULFURIC ACID. Always add sulfuric acid to water. To prevent excessive heat generation and spattering, add sulfuric acid in small amounts over the entire surface of the solution and with constant agitation.

PROTECTIVE EQUIPMENT:

When using ARP 60 and sulfuric acid, wear rubber gloves, rubber apron, rubber boots, safety goggles and face shield. Avoid breathing mist or vapor. Use with adequate ventilation. Use an OSHA-approved dust mask when handling ARP 60 powder. Wash thoroughly after handling.

FIRST AID (ARP 60 OR SULFURIC ACID)

IN CASE OF EYE OR SKIN CONTACT: immediately flush with large amounts of water for at least 15 minutes. Call a physician immediately.

IF SULFURIC ACID IS SWALLOWED: call a physician immediately. DO NOT induce vomiting. If conscious, have victim drink large quantities of water. Never give anything by mouth to an unconscious person.

IF INHALED: remove victim to fresh air and call a physician. Remove and wash contaminated clothing before reuse. Discard contaminated shoes.

SPILL OR LEAK

Wear protective equipment during cleanup of a spill or leak. Sweep up powder spill. Absorb liquid spill with an inert material such as sand, earth or vermiculite. Dispose of all residue consistent with federal, state and local regulations.

REQUIRED READING

ARP 60 is for industrial use only. Read Material Safety Data Sheet and product label before using. Also, follow supplier's safety recommendations for all other chemicals mentioned in this technical bulletin.

NOTE: All gallon measurements are U. S. Gallons

ARP 66

NON-CYANIDE ELECTROLESS NICKEL STRIPPER

ARP 66 is a high-speed, cyanide-free immersion stripper for electroless nickel deposits. The easy-to-operate, two-component system is designed to rapidly strip all types of electroless nickel deposits from ferrous-based alloys without attacking the substrate, even when stripping takes place overnight.

In addition to its rapid stripping rate, the ARP 66 system provides other benefits to the user. The solution is stable, even at high temperatures, which extends the life of the bath. And because stripping is accomplished strictly by immersion, racking is unnecessary and current distribution is not a concern.

STRIPPING CYCLE:

1. Clean parts cathodically in an alkaline cleaner recommended by your Allied-Kelite representative.

2. Activate parts in a 50% hydrochloric acid pickle.

3. Rinse parts thoroughly in water.

4. Totally immerse parts in the ARP 66 bath, with agitation. Parts can be stripped most efficiently in a barrel, provided the barrel can withstand the high operating temperature.

5. When stripping is completed, remove parts and rinse thoroughly in water.

6. If black smut or film remains on parts, remove with ISOPREP 177, or with 50% HCI pickle.

7. Rinse parts thoroughly in water.

NOTE: Before replating stripped parts with electroless nickel, consult your Allied-Kelite representative for proper preplate cycles.

OPERATING DATA:

Equipment:

Use mild steel or stainless steel for ARP 66 tanks and heating coils. VENTILATION IS NECESSARY.

Operating Conditions:

ARP 66A	8 oz/gal (60 g/L)
ARP 66B	50% by volume
Solution Temperature	125-210F (52-99C)
	200F (93C) preferred

Stripping Rate	0.0005-0.0015 in/hr (13-38 um/hr) for new bath (Depends on temp., agitation and age of bath.)
Agitation	Required for best efficiency

Solution Makeup

1. Add required amount of ARP 66B.

2. Add required amount of ARP 66A, and stir until dissolved.

3. Add water to operating level and stir thoroughly.

4. Heat solution to preferred operating temperature.

WARNING: Never add acid solutions to the ARP 66 working solution, and never add ARP 66B to acid solutions, because of possible liberation of dangerous hydrogen sulfide gas.

Solution Maintenance:

During stripping operation, a black film or smut forms on the work, indicating that the ARP 66 bath is operating normally. If the black film does not appear on the work, it indicates the following:

1. The nickel is passive or it is not clean and needs activation or recleaning.

2. The bath requires replenishment additions of ARP 66A and ARP 66B. Usually, additions of 12.5% by volume ARP 66B and 2 oz/gal (15g/L) ARP 66A (same ratio as original makeup) will restore stripping activity.

If stripping activity is not restored by incremental additions, loss in activity may be due to copper poisoning, excessive amounts of sludge, or high nickel content. For copper poisoning, add larger amounts of ARP 66B. For excessive sludge or nickel content, discarding of spent bath is suggested.

WASTE DISPOSAL:

Spent baths should be disposed of in accordance with current regulations and codes.

STANDARD PACKAGES:

ARP 66A	200 pound
ARP 66B	5 gallon
	55 gallon

CAUTION......ARP 66A compound dust may be irritating. Exercise caution in its use. ARP 66B is alkaline and contact with skin and eyes should be avoided. Carefully read precautionary and first-aid information on container label. Wear protective clothing, gloves and goggles. Ventilation of work area is necessary.

WARNING: Never add acid solutions to the ARP 66 working solution, and never add ARP 66B to acid solutions, because of possible liberation of dangerous hydrogen sulfide gas.

NOTE: All gallon measurements are U. S. Gallons

APPENDIX B

DETAILED BIODEGRADABILITY PROTOCOL

The following pages contain the detailed procedures followed for testing noncyanide stripper formulations for biodegradation in an activated sludge system.

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A. TEST CONFIGURATION

The activated sludge from Tinker AFB is maintained in a culture column with air circulation, with siphon activated maximum volume overflow wasting, and with constant nutrient additions. Solids are maintained at approximately 2.5 grams/liter. The test configuration (columns) is shown in Table A-1 below.

TABLE A-1. TEST CONFIGURATION

Time (hours)	Test Columns 1	2	3	4	5	6 (Phenol)
0	2F[a] 2ATP[b]	2F 2ATP	2F 2ATP	2F 2ATP	2F 2ATP	2F 2ATP
1	2F 2UF[c]	2F	2F	2F	2F	2F
2	2F	2F	2F	2F	2F	2F
3	2F	2F	2F	2F	2F	2F
4	2F	2F	2F	2F	2F	2F
5	2F 2UF	2F	2F	2F	2F	2F
6	2F 2ATP	2F 2ATP	2F 2ATP	2F 2ATP	2F 2ATP	2F 2ATP

a. 2F = 2 filtered (2-mL) samples for COD analysis.
b. 2ATP = 2 unfiltered (1-mL) samples for adenosine triphosphate.
c. 2UF = 2 unfiltered (2-mL) samples for COD analysis.

B. SOLIDS

Activated sludge, brought to this lab from Tinker AFB's IWTP, is concentrated by centrifugation at 5°C and 5000 rpm. The elutrient is discarded and the pellet is collected in a container which is stored in a refrigerator at 5°C. The moisture content of the concentrated sludge is determined by adding 1.0 grams of wet concentrated sludge to a preweighed

pan. The material is dried to a constant weight at 105^{o}C in a drying oven. The percent of solids is determined by:

$$\frac{\text{dry weight}}{\text{wet weight}} \times 100 = \%\ \text{solids}$$

This value is used to determine the amount of concentrated sludge added to the column.

$$\frac{2.5\ \text{grams solids/liter}}{\%\ \text{Solids}} \times 4\ \text{liters of column} = \text{amount of wet solids added to the column}$$

C. COLUMN SETUP

- o Four liters of dilution medium is added to the column, and air agitation is turned on.
- o Agitation is continued for 5 minutes to permit mixing and oxygenation of the solution prior to the addition of solids.
- o The preweighed solids are added to the column.
- o One gram of ferric sulfate is added to the column.
- o Nutrient feed is started to the column.
- o Following 1/2-hour mixing period, a 50 mL sample is pulled in a glass beaker, a magnet bar is added, and the sample is placed on a stirring plate. The pH of the solution is measured using a calibrated pH probe. This solution is then discarded.
- o A 25 mL sample of the culture column material is added to a preweighed drying tin. The sample is placed in a 105^{o}C drying oven and dried to a constant weight.

1. Comments:

    a. The air flow in the column should be adjusted to prevent excessive bumping, but adequate mixing.

    b. Check all feed and waste discharge lines for proper flow.

c. Prepare a slide for microscopic observation of the column material.

D. DILUTION MEDIUM

The EPA nutrient medium used for maintaining the activated sludge is made of the following materials (see Table A-2).

1 liter deionized water (DIW)
1 milliliter solution I
1 milliliter solution II
1 milliliter solution III

TABLE A-2. DILUTION MEDIUM COMPOSITION

Solution	Compound	g/L
I	NH_4Cl	35
	KNO_3	15
	$K_2HPO_4 \cdot 3H_2O$ . .	75
	$NaH_2PO_4 \cdot H_2O$ . .	25
II	KCl	10
	$MgSO_4$	20
	$FeSO_4 \cdot 7H_2O$ . .	1
	(adjust pH to 3.0)	
III	$CaCl_2$	5
	$ZnCl_2$	0.05
	$MnCl_2 \cdot 4H_2O$ . .	0.5
	$CuCl_2$	0.05
	$CoCl_2$	0.001
	H_3BO_3	0.001
	MoO_3	0.0004

*Federal Register (September 27, 1985), volume 50, number 188, page 39279.
Refrigerate the solutions.

E. NUTRIENT SUPPLEMENT PREPARATION

The following addresses the nutrient feed solution of phenol, nitrogen, and phosphorus added daily. The ratio of 10:5:1 (C:N:P) is the operating premise. Iron is added as an additional supplement for good floc growth.

The average phenol feed is assumed to be 100 ppm (similar to pilot plant maintenance feed requirements). The feed rate of 16 L per day would offer a 4.0 turnover rate of the column (4 L volume), similar to the pilot plant and IWTP at Tinker AFB.

100 ppm - carbon, (100 mg/liter)(16.0 liters)	=	1.60 g C/day
50 ppm - nitrogen, (50 mg/liter)(16.0 liters)	=	0.80 g N/day
10 ppm - phosphorus, (10 mg/liter)(16.0 liters)	=	0.16 g P/day
5 ppm - iron, (5 mg/liter)(16.0 liters)	=	0.08 g Fe/day

For the source of carbon, phenol is added at a rate of 1.60 grams of phenol daily.

Ammonium chloride (NH_4Cl) is used as the source of nitrogen. The nitrogen in ammonium chloride represents approximately 26 percent of the formula weight; therefore, (0.8 grams N/day)/(26 percent N/NH_4Cl) = 3.077-grams NH_4Cl/day is required in the nutrient feed.

Potassium phosphate (KPO_4) is used as the source of phosphorus. The phosphorus in potassium phosphate represents approximately 13 percent of the formula weight; therefore, (0.16 grams P/day)/(13 percent P/KPO_4) = 1.231-grams KPO_4/day is required in the nutrient feed.

Ferric Chloride ($FeCl_3$) is used as the source of iron. The iron in ferric chloride represents approximately 34.5 percent of the formula weight; therefore, (0.08-grams Fe/day)/34.5 percent Fe/$FeCl_3$) = 0.232-grams $FeCl_3$ is required in the nutrient feed.

F. FEED/FLOW RATE CALCULATIONS

Based on a feed flow rate of 0.75 mL/min, the amount of materials needed to be in a liter of the biodegradation solution can be calculated by:

(0.75 mL/min)(60 min/hour)(24 hours/day) = 1080 mL/day, or 1.08 Liters/day

Therefore, in making up the nutrient feed for the columns, the following compounds must be added in the amounts indicated.

$$\frac{(1.60 \text{ g Phenol/day})}{(1.08\text{L/day})} = \underline{1.481 \text{ g/L}}$$

$$\frac{(3.077 \text{ g Ammonium Chloride/day})}{(1.08 \text{ L/day})} = \underline{2.849 \text{ g/L}}$$

$$\frac{(1.231 \text{ g Potassium Phosphate/day})}{(1.08 \text{ L/day})} = \underline{1.140 \text{ g/L}}$$

$$\frac{(0.232 \text{ g Ferric Chloride/day})}{(1.08 \text{ L/day})} = \underline{0.215 \text{ g/L}}$$

Volume Prepared (liters)	Phenol (grams)	Ammonium Chloride (grams)	Potassium Phosphate (grams)	Ferric Chloride (grams)
1	1.481	2.849	1.140	0.215
2	2.962	5.698	2.280	0.430
3	4.443	8.547	3.420	0.645

- The ammonium chloride, potassium phosphate (monobasic), and ferric chloride are added to the basic nutrient media.
- The solution is sterilized, 121^{o}C, 20 psi, 20 minutes
- The solution is cooled to room temperature, and
- The phenol additive is prepared by:

  a) dissolve phenol in 50 mL of deionized water
  b) filter sterilize.

- Add the phenol to the media.
- The nutrient media is attached, aseptically, to the nutrient feed pump.

G. TEST SET-UP PROCEDURES

During the biodegradation test, the basic EPA nutrient medium is used to dilute the solvent and culture material in the test columns.

The test columns are filled to a total volume of about 250 mL

- 0.417 mL of most concentrated manufacturer's recommended mix of solvent (based on a 1:600 dilution, which is a typical IWTP dilution ratio at Tinker AFB)

- 225 mL of solvent and basic EPA nutrient media (appropriate dilution, concentration).

- 25 mL of culture column microorganisms

COD determinations are run according to HACH Chemical procedures.

ATP determinations are run according to the internal standard method of Turner Instruments, Inc.

2 mL samples are filtered using a syringe-filter system equipped with a 0.45-micron pore-size filter.

Dry weights are determined on the culture column and initial samples at the beginning and end of the test runs. Twenty-five mL samples of material are placed in a preweighed drying pan which is placed in a drying oven (103^{o}C) until the sample is dry. The pan is reweighed, and the difference between the initial and final pan weights divided by the volume placed in the drying pan gives solid dry weights per unit volume.

COD values are compared to a control phenol column run simultaneously during each test period.

Also, COD values are compared to each other based on solid dry weights, ATP, and relative phenol degradations.

H. ATP PROCEDURE

Set ATP Photometer: 3-second delay, 10-second integration period

Reading Unknown (RU)

1. 50-mL sample in 8 X 50 mm polypropylene tube
2. Add 50-mL releasing agent, mix, and let stand 30 seconds
3. Add 50-mL HEPES buffer
4. Place in photometer
5. Inject 100-mL Luciferin-Luciferase (L&L)
6. Record full integral

Reading Internal Standard (RIS)

1. 50-mL sample in 8 X 50 mm polypropylene tube
2. Add 50-mL Releasing Agent, mix, and let stand 30 seconds
3. Add 50-mL ATP Standard, 2.5-E-2uG/mL ATP
4. Place in photometer
5. Inject 100-mL Luciferin-Luciferase (L&L)
6. Record full integral

Reading the Blank (RB)

1. 50-mL distilled water in 8 X 50mM polypropylene tube
2. Add 50-mL Releasing Agent, mix, and let stand 30 seconds
3. Add 50-mL HEPES buffer
4. Place in photometer
5. Injects 100-mL Luciferin-Luciferase (L&L)
6. Record full integral

Reagents

Releasing Agent - purchased, ready-to-go from Turner Designs, Inc.
HEPES buffer - purchased, ready-to-go from Turner Designs, Inc.

ATP Standard - purchased as a concentrated, sterile liquid from Turner Designs, Inc., see the following page for preparation details

Luciferin-Luciferase - purchased as a sterile, dry powder (5.5 mL preparation volume) from Turner Designs, Inc., see the following page for preparation details

KEEP ALL REAGENTS REFRIGERATED AND COOLED
ATP STANDARD SHOULD BE FROZEN BETWEEN TESTING PERIODS
DISCARD ANY THAWED L&L FOLLOWING THE DAILY TEST PERIOD

I. ATP STANDARDS PREPARATION

1. Fill dewar with liquid nitrogen.
2. Calibrate 100-ml pipet (Eppendorf) to deliver 25- mL, by weight using the microbalance, 0.2500 grams/10 deliveries.
3. Use a 10-mL volumetric pipet to deliver 10-mL of sterile HEPES buffer into five clean plastic tubes.
4. Pipet 25-mL of ATP Standard (5-mL bottle, blue label, liquid, Turner Designs) into each 10-mL tube.
5. Vortex mix each tube following the addition of the ATP standard.
6. Pipet 2-mL of the diluted standard into blue, snap cap tubes.
7. Place the 2-mL ATP standards in the liquid nitrogen.
8. Continue steps 5 - 8 until the five test tubes of HEPES buffer have been used.
9. Remove the prepared standards from the liquid nitrogen and place them in a labelled beaker (indicating the date of preparation and the people who prepared them) and place the beaker in the freezer.

J. LUCIFERIN-LUCIFERASE PREPARATION

1. Remove 5 or 6 bottles of L&L (green labels, Turner Designs) from the refrigerator.
2. Using a 10-mL syringe (calibrated to 0.2 mL volume), add 5.5 mL of sterile HEPES buffer to 3 of the bottles of L&L.
3. Using a 1 mL pipet, transfer 1 mL of the L&L into a blue, snap-cap, conical plastic tube.
4. Close the cap and place the tube in liquid nitrogen.
5. After all of the bottles have been made up, remove the prepared L&L tubes from the liquid nitrogen and place them in a labelled beaker (indicating the date of preparation and the people who prepared them) and place the beaker in the freezer.

K. COD STANDARD PREPARATION

Do not add dry chemical or strong acid/base to a dry volumetric flask; therefore, add approximately 10 mL of nanopure water to 3-100 mL volumetric flasks.

Mark one of the three volumetric flasks as number "1". This is the initial solution flask. Mark the other two flasks as "A" and "B". These will be the two standards, actually measured.

1. Initial Solution

- o Weigh out 9.80 grams of ferrous ammonium sulfate (FAS) and add this to the volumetric flask.
- o Using a 2-mL volumetric pipet, transfer 2 ml of concentrated sulfuric acid to the volumetric flask.
- o Bring the volume in the volumetric flask to about 3/4 total volume.
- o Swirl the flask until all of the FAS crystals have dissolved.
- o Bring the flask volume to the mark with nanopure water and seal with parafilm.
- o Invert the volumetric at least 13 times, allowing the neck to fill and empty completely each time (rotate the flask slightly each inversion also).

2. Standard Solution A

- o Using the Solution 1, fill a 10-mL volumetric pipet to just above the mark.
- o Empty the pipet into a large volume waste beaker.
- o Draw a second volume of a solution to the mark and transfer this volume to the volumetric flask labelled "A".
- o Fill the volumetric flask to the mark with nanopure water, seal with parafilm, and invert at least 13 times (same as making the initial solution).
- o Rinse a small, clean, plastic weigh boat with this solution.
- o Discard the rinse into the waste beaker.
- o Fill the weigh boat again with this solution and transfer 2 mL's of this solution to two separate COD analysis tubes.
- o Vortex the tubes and place them in the COD incubator.

3. Standard Solution B

Using Solution 1, fill a 25-mL volumetric pipet to just above the mark.
Empty the pipet into a large volume waste beaker.
Draw a second volume of a solution to the mark and transfer this volume to the volumetric flask labelled "B".
Fill the volumetric flask to the mark with nanopure water, seal with parafilm, and invert at least 13 times (same as making the initial solution).
Rinse a small, clean, plastic weigh boat with this solution.
Discard the rinse into the waste beaker.
Fill the weigh boat again with this solution and transfer 2 mL of this solution to two separate COD analysis tubes.
Vortex the tubes and place them in the COD incubator.

NOTES:

When you are through with the solutions prepared for COD analysis:

a. Discard remaining solutions into the waste solution beaker.
b. Add an equal amount of water to dilute the acidic solution.
c. Neutralize and discard this solution (it is only an iron precipitate).
d. Rinse the volumetric flasks (fill and dump) three times with tap water.
e. Wash the outside of the volumetric flasks with soap and hot water.
f. Rinse the volumetric flasks (fill and dump) three times with tap water.
g. Rinse the volumetric flasks (fill and dump) three times with deionized water.
h. Rinse the volumetric flasks (fill and dump) three times with nanopure water.
i. Invert the volumetric flasks and place them on a drying rack.

L. BASIC CALCULATIONS

$$\text{ATP in sample (g/mL)} = \frac{(RU - RB)}{(RIS - RU)} \times \text{ATP in standard}^{*}\text{(g/mL)}$$

$$\text{Solids in sample (g/mL)} = \frac{\text{pan dry weight (final-initial, grams)}}{\text{volume of sample (mL)}}$$

$$\text{ATP per gram solids (g/g)} = \frac{\text{ATP in sample}}{\text{Solids in sample}}$$

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* 2.5×10^{-8} g ATP/mL (Standard concentration currently prepared).

APPENDIX C

STRIPPING RATE DATA

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NON CYANIDE STIPPERS

RECORD #	DATE	MATERIAL	INITIAL	CHANGE	DIMENSIONS	AREA	TIME	RATE	
** CIRCUIT CHEM. CORP.		CIRSTRIP NCN-CU A,B							
5	05/19/88	17-4 PH	28.7836	-0.0018	1X2X1/8	30.65	24.00	0.0000	
328	09/28/88	17-4 PH	28.7705	0.0001	1X2X1/8	30.65	23.90	0.0000	BDL
16	05/18/88	309 SS	29.0234	0.0005	1X2X1/8	30.65	24.00	0.0000	BDL
3	05/19/88	316 SS	29.4021	-0.0009	1X2X1/8	30.65	24.00	0.0000	
327	09/28/88	410 SS	26.9686	0.0005	1X2X1/8	30.65	23.91	0.0000	BDL
382	10/19/88	410 SS	26.9344	0.0002	1X2X1/8	30.65	23.10	0.0000	BDL
326	09/28/88	8740	30.8680	0.0007	1X2X1/8	30.65	23.98	0.0000	BDL
385	10/19/88	8740	30.8613	0.0010	1X2X1/8	30.65	23.25	0.0001	
386	10/19/88	8740	31.0260	0.0010	1X2X1/8	30.65	23.35	0.0001	
387	10/19/88	8740	31.0260	0.0010	1X2X1/8	30.65	23.25	0.0001	
15	05/18/88	9310	30.8463	0.0410	1X2X1/8	30.65	24.00	0.0024	
325	09/28/88	9310	59.6233	0.0003	1X2X1/4	36.12	23.96	0.0000	BDL
383	10/19/88	9310	30.7930	0.0004	1X2X1/8	30.65	23.47	0.0000	BDL
384	10/19/88	9310	31.1504	0.0001	1X2X1/8	30.65	23.41	0.0000	BDL
6	05/19/88	A286	14.5113	-0.0001	1X2X1/16	27.91	24.00	0.0000	BDL
9	05/17/88	AL 1100	8.9629	-0.0005	1X2X1/8	30.65	24.00	0.0000	BDL
324	09/28/88	BRONZE, FUMING	3.7334	0.8291	3.99" ROD	7.61	1.00	4.8752	
390	10/21/88	BRONZE, FUMING	3.7664	-0.0300	4.00" ROD	7.67	0.67	0.0000	
12	05/17/88	C276	33.0279	0.0000	1X2X1/8	30.65	24.00	0.0000	BDL
17	05/18/88	C276	33.1255	0.0001	1X2X1/8	30.65	24.00	0.0000	BDL
14	05/18/88	C4340	28.3043	-0.0001	1X2X1/8	30.65	24.00	0.0000	BDL
329	09/28/88	C4340	28.7633	0.0000	1X2X1/8	30.65	23.85	0.0000	BDL
320	09/28/88	CADMIUM	13.0446	0.6437	1X2X1/16	27.91	6.08	0.1727	
391	10/21/88	CADMIUM	12.8819	0.2055	1X2X1/16	27.91	6.00	0.0559	
323	09/28/88	CDA 101	18.2910	4.1254	1X2X1/16	27.91	1.16	5.6430	
392	10/21/88	CDA 101	29.5069	3.2911	1X2X1/8	30.65	0.67	7.0974	
10	05/17/88	CHROMIUM	23.4945	0.0003	1X2X1/8	30.65	24.00	0.0000	BDL
13	05/18/88	HASTELOY X	31.9123	0.0018	1X2X1/8	30.65	24.00	0.0001	
11	05/17/88	INCONEL 625	32.7790	0.0001	1X2X1/8	30.65	24.00	0.0000	BDL
1	05/18/88	INCONEL 625	32.6491	-0.0001	1X2X1/8	30.65	24.00	0.0000	BDL
322	09/28/88	INDIUM	15.9357	0.2900	1X2X1/16	27.91	6.58	0.0852	
394	10/21/88	INDIUM	28.5783	0.2608	1X2X1/8	30.65	6.00	0.0765	
2	05/19/88	LEAD	22.6232	-0.0002	1X2X1/16	27.91	24.00	0.0000	BDL
4	05/19/88	NI200	30.1175	0.0006	1X2X1/8	30.65	24.00	0.0000	BDL

393	10/21/88	NI200	26.0136	0.0025	1X2X1/8	30.65	6.00	0.0006	
321	09/28/88	SILVER	34.5545	0.9872	1X2X1/8	30.65	6.50	0.1858	
319	09/28/88	TIN	13.1194	0.0006	1X2X1/16	27.91	6.66	0.0000	BDL
** CIRCUIT CHEM. CORP.		NICSTRIP NCN-SCB							
198	08/11/88	17-4 PH	35.7718	7.6947	1X2X1/8	30.65	26.28	0.4822	
199	08/11/88	309 SS	30.0220	0.0001	1X2X1/8	30.65	26.37	0.0000	BDL
197	08/11/88	A286	14.4672	0.0003	1X2X1/16	27.91	26.05	0.0000	BDL
190	08/11/88	BRONZE, FUMING	3.6895	0.0024	3.94" ROD	7.52	24.33	0.0006	
196	08/11/88	C4340	28.6185	0.0009	1X2X1/8	30.65	26.17	0.0001	
191	08/11/88	CADMIUM	12.5978	3.7957	1X2X1/16	27.91	25.42	0.2435	
192	08/11/88	CDA 101	30.0514	0.0028	1X2X1/8	30.65	24.58	0.0002	
193	08/11/88	LEAD	22.4658	0.1518	1X2X1/16	27.91	0.42	0.4471	
194	08/11/88	NI200	32.3830	0.0007	1X2X1/8	30.65	24.33	0.0000	BDL
195	08/11/88	SILVER	36.8252	0.0035	1X2X1/8	30.65	24.92	0.0002	
200	08/11/88	TIN	24.9571	0.0959	1X2X1/8	30.65	24.58	0.0069	
201	08/11/88	TUNGS-CARB.	69.7014	0.0480	1X2X1/4	36.12	24.00	0.0218	
** CN		CN ELECTROLYTIC							
86	07/08/88	17-4 PH	28.8735	0.1975	1X2X1/8	30.65	24.00	0.0136	
158	07/12/88	17-4 PH	28.9570	0.1182	1X2X1/8	30.65	24.00	0.0081	
161	07/13/88	17-4 PH	29.5649	0.2836	1X2X1/8	30.65	24.00	0.0195	
88	07/07/88	8740	30.9487	0.0235	1X2X1/8	30.65	24.00	0.0016	
157	07/12/88	8740	31.0763	0.0339	1X2X1/8	30.65	24.00	0.0023	
163	07/13/88	8740	60.0617	0.1171	1X2X1/4	36.12	24.00	0.0068	
87	07/07/88	9310	31.0421	0.0165	1X2X1/8	30.65	24.00	0.0010	
156	07/12/88	9310	30.8586	0.0307	1X2X1/8	30.65	24.00	0.0018	
162	07/13/88	9310	60.8478	0.1188	1X2X1/4	36.12	24.00	0.0060	
89	07/07/88	A286	14.4364	0.0848	1X2X1/16	27.91	24.00	0.0063	
155	07/12/88	A286	13.9868	0.0712	1X2X1/16	27.91	24.00	0.0053	
160	07/13/88	A286	14.5450	0.0217	1X2X1/16	27.91	24.00	0.0016	
146	07/07/88	AL 1100	28.8735	0.1975	1X2X1/8	30.65	24.00	0.0390	
170	07/18/88	BRONZE, FUMING	2.8646	0.2235	3.06" ROD	5.86	24.00	0.0711	
133	07/27/88	BRONZE, FUMING	3.7323	3.5878	3.99" ROD	7.61	3.41	6.1885	
139	07/28/88	BRONZE, FUMING	3.7473	0.6651	4.00" ROD	7.64	0.75	5.1955	
90	07/07/88	C4340	28.4856	0.0298	1X2X1/8	30.65	24.00	0.0020	
154	07/12/88	C4340	28.9748	0.0422	1X2X1/8	30.65	24.00	0.0029	
171	07/13/88	C4340	28.7450	0.0384	1X2X1/8	30.65	24.00	0.0026	
169	07/18/88	CADMIUM	13.1395	7.9319	1X2X1/16	27.91	1.00	12.9351	

	393	10/21/88	NI200	26.0136	0.0025	1X2X1/8	30.65	6.00	0.0006
	321	09/28/88	SILVER	34.5545	0.9872	1X2X1/8	30.65	6.50	0.1858
	319	09/28/88	TIN	13.1194	0.0006	1X2X1/16	27.91	6.66	0.0000 BDL
**	CIRCUIT CHEM. CORP.		NICSTRIP NCN-SCB						
	198	08/11/88	17-4 PH	35.7718	7.6947	1X2X1/8	30.65	26.28	0.4822
	199	08/11/88	309 SS	30.0220	0.0001	1X2X1/8	30.65	26.37	0.0000 BDL
	197	08/11/88	A286	14.4672	0.0003	1X2X1/16	27.91	26.05	0.0000 BDL
	190	08/11/88	BRONZE, FUMING	3.6895	0.0024	3.94" ROD	7.52	24.33	0.0006
	196	08/11/88	C4340	28.6185	0.0009	1X2X1/8	30.65	26.17	0.0001
	191	08/11/88	CADMIUM	12.5978	3.7957	1X2X1/16	27.91	25.42	0.2435
	192	08/11/88	CDA 101	30.0514	0.0028	1X2X1/8	30.65	24.58	0.0002
	193	08/11/88	LEAD	22.4658	0.1518	1X2X1/16	27.91	0.42	0.4471
	194	08/11/88	NI200	32.3830	0.0007	1X2X1/8	30.65	24.33	0.0000 BDL
	195	08/11/88	SILVER	36.8252	0.0035	1X2X1/8	30.65	24.92	0.0002
	200	08/11/88	TIN	24.9571	0.0959	1X2X1/8	30.65	24.58	0.0069
	201	08/11/88	TUNGS-CARB.	69.7014	0.0480	1X2X1/4	36.12	24.00	0.0218
**	CN		CN ELECTROLYTIC						
	86	07/08/88	17-4 PH	28.8735	0.1975	1X2X1/8	30.65	24.00	0.0136
	158	07/12/88	17-4 PH	28.9570	0.1182	1X2X1/8	30.65	24.00	0.0081
	161	07/13/88	17-4 PH	29.5649	0.2836	1X2X1/8	30.65	24.00	0.0195
	88	07/07/88	8740	30.9487	0.0235	1X2X1/8	30.65	24.00	0.0016
	157	07/12/88	8740	31.0763	0.0339	1X2X1/8	30.65	24.00	0.0023
	163	07/13/88	8740	60.0617	0.1171	1X2X1/4	36.12	24.00	0.0068
	87	07/07/88	9310	31.0421	0.0165	1X2X1/8	30.65	24.00	0.0010
	156	07/12/88	9310	30.8586	0.0307	1X2X1/8	30.65	24.00	0.0018
	162	07/13/88	9310	60.8478	0.1188	1X2X1/4	36.12	24.00	0.0060
	89	07/07/88	A286	14.4364	0.0848	1X2X1/16	27.91	24.00	0.0063
	155	07/12/88	A286	13.9868	0.0712	1X2X1/16	27.91	24.00	0.0053
	160	07/13/88	A286	14.5450	0.0217	1X2X1/16	27.91	24.00	0.0016
	146	07/07/88	AL 1100	28.8735	0.1975	1X2X1/8	30.65	24.00	0.0390
	170	07/18/88	BRONZE, FUMING	2.8646	0.2235	3.06" ROD	5.86	24.00	0.0711
	133	07/27/88	BRONZE, FUMING	3.7323	3.5878	3.99" ROD	7.61	3.41	6.1885
	139	07/28/88	BRONZE, FUMING	3.7473	0.6651	4.00" ROD	7.64	0.75	5.1955
	90	07/07/88	C4340	28.4856	0.0298	1X2X1/8	30.65	24.00	0.0020
	154	07/12/88	C4340	28.9748	0.0422	1X2X1/8	30.65	24.00	0.0029
	171	07/13/88	C4340	28.7450	0.0384	1X2X1/8	30.65	24.00	0.0026
	169	07/18/88	CADMIUM	13.1395	7.9319	1X2X1/16	27.91	1.00	12.9351

134	07/27/88	CADMIUM	13.2088	3.2506	1X2X1/16	27.91	3.42	1.5500	
140	07/28/88	CADMIUM	12.7225	5.9231	1X2X1/16	27.91	0.75	12.8788	
373	10/06/88	CDA 101	27.7032	8.6473	1X2X1/8	30.65	3.42	3.6533	
374	10/06/88	CDA 101	3.0007	2.8390	3.08 IN	5.89	2.42	8.8157	
375	10/06/88	CDA 101	3.1964	2.9751	3.12 IN	5.97	2.42	9.1216	
165	07/18/88	INDIUM	15.6418	3.1146	1X2X1/16	27.91	24.00	0.2508	
135	07/27/88	INDIUM	15.4595	5.2237	1X2X1/16	27.91	3.42	2.9515	
143	07/28/88	INDIUM	15.9354	0.0006	1X2X1/16	27.91	0.75	0.0000	BDL
168	07/18/88	LEAD	21.9055	2.2593	1X2X1/16	27.91	17.50	0.1597	
137	07/27/88	LEAD	21.9035	1.3716	1X2X1/16	27.91	3.41	0.4977	
141	07/28/88	LEAD	21.9724	7.0137	1X2X1/16	27.91	18.25	0.4755	
166	07/18/88	NI200	33.3041	0.0918	1X2X1/8	30.65	24.00	0.0055	
138	07/27/88	NI200	32.5812	0.1450	1X2X1/8	30.65	3.25	0.0645	
142	07/28/88	NI200	30.0437	0.1464	1X2X1/8	30.65	24.00	0.0088	
370	10/06/88	NI200	31.7507	0.0777	1X2X1/8	30.65	5.42	0.0207	
371	10/06/88	NI200	32.4099	0.0834	1X2X1/8	30.65	5.42	0.0222	
372	10/06/88	NI200	33.2555	0.0800	1X2X1/8	30.65	5.42	0.0213	
167	07/18/88	SILVER	37.7085	12.8318	1X2X1/8	30.65	1.00	15.6977	
136	07/27/88	SILVER	37.9651	6.4932	1X2X1/8	30.65	0.25	31.7736	
144	07/28/88	SILVER	38.0542	4.3470	1X2X1/8	30.65	0.16	33.2364	
127	08/02/88	TUNGS-CARB.	69.9369	25.1887	1X2X1/8	30.65	13.00	24.8885	
128	08/02/88	TUNGS-CARB.	69.9907	25.8502	1X2X1/8	30.65	13.00	25.5421	
129	08/02/88	TUNGS-CARB.	70.6145	12.0068	1X2X1/8	30.65	13.00	11.8637	
130	08/02/88	TUNGS-CARB.	70.2426	0.0537	1X2X1/8	30.65	24.00	0.0287	
** CN		CN IMMERSION							
109	06/23/88	8740	31.0766	0.0005	1X2X1/8	30.65	2.00	0.0000	BDL
94	06/24/88	8740	30.8781	-0.0001	1X2X1/8	30.65	24.00	0.0000	BDL
111	06/27/88	8740	30.6795	0.0002	1X2X1/8	30.65	24.00	0.0000	BDL
110	06/29/88	8740	30.9491	0.0006	1X2X1/8	30.65	25.00	0.0000	BDL
106	07/01/88	9310	30.7866	0.0006	1X2X1/8	30.65	24.50	0.0000	BDL
108	07/05/88	9310	30.8590	0.0004	1X2X1/8	30.65	24.00	0.0000	BDL
107	07/06/88	9310	30.8546	0.0001	1X2X1/8	30.65	24.00	0.0000	BDL
103	07/01/88	A286	14.2859	0.0000	1X2X1/16	27.91	24.50	0.0000	BDL
105	07/05/88	A286	14.4212	0.0001	1X2X1/16	27.91	24.00	0.0000	BDL
104	07/06/88	A286	14.5220	0.0003	1X2X1/16	27.91	24.00	0.0000	BDL
100	07/05/88	BRONZE, FUMING	4.7019	2.4001	5.03" ROD	9.56	1.00	11.2325	
99	07/06/88	BRONZE, FUMING	4.7534	1.6444	5.08" ROD	9.66	0.50	15.2260	
101	07/01/88	C4340	28.7707	0.0004	1X2X1/8	30.65	24.50	0.0000	BDL
102	07/05/88	C4340	28.4102	0.0010	1X2X1/8	30.65	24.00	0.0001	

115	06/23/88	CADMIUM	14.2030	4.3336	1X2X1/16	27.91	2.00	3.5335	
92	06/24/88	CADMIUM	14.1018	4.3118	1X2X1/16	27.91	2.00	3.5157	
117	06/27/88	CADMIUM	14.2378	4.2890	1X2X1/16	27.91	2.00	3.4972	
116	06/29/88	CADMIUM	13.8180	7.0678	1X2X1/16	27.91	2.00	5.7629	
179	07/01/88	CDA 101	29.7868	5.4854	1X2X1/8	30.65	4.00	1.9814	
177	07/05/88	CDA 101	30.6328	1.0013	1X2X1/8	30.65	1.00	1.4468	
178	07/06/88	CDA 101	30.6021	0.6455	1X2X1/8	30.65	0.50	1.8654	
112	06/23/88	INDIUM	15.6173	-0.0004	1X2X1/16	27.91	2.00	0.0000	BDL
93	06/24/88	INDIUM	15.6421	-0.0002	1X2X1/16	27.91	2.00	0.0000	BDL
114	06/27/88	INDIUM	16.1275	-0.0002	1X2X1/8	30.65	2.00	0.0000	BDL
113	06/29/88	INDIUM	15.9346	-0.0006	1X2X1/16	27.91	2.00	0.0000	BDL
175	07/05/88	LEAD	22.6077	0.8694	1X2X1/16	27.91	1.00	1.0757	
176	07/06/88	LEAD	22.6826	0.6030	1X2X1/16	27.91	0.50	1.4922	
182	06/23/88	NI200	30.6378	0.8707	1X2X1/8	30.65	2.00	0.6290	
91	06/24/88	NI200	30.2965	0.1394	1X2X1/8	30.65	2.00	0.1007	
181	06/27/88	NI200	30.2107	0.1802	1X2X1/8	30.65	2.00	0.1302	
180	06/29/88	NI200	30.0437	0.0001	1X2X1/8	30.65	2.00	0.0000	BDL
376	10/07/88	NI200	33.6755	0.0174	1X2X1/8	30.65	5.42	0.0046	
377	10/07/88	NI200	31.8273	0.0218	1X2X1/8	30.65	5.33	0.0059	
378	10/07/88	NI200	31.9445	0.0172	1X2X1/8	30.65	5.42	0.0046	
183	06/23/88	SILVER	37.8511	4.1032	1X2X1/8	30.65	2.00	2.5098	
147	06/24/88	SILVER	37.7779	3.0771	1X2X1/8	30.65	2.00	1.8821	
173	06/27/88	SILVER	38.3380	1.2990	1X2X1/8	30.65	1.00	1.5892	
174	06/29/88	SILVER	38.5128	5.6281	1X2X1/8	30.65	2.00	3.4425	
131	08/02/88	TUNGS-CARB.	70.9635	0.0946	1X2X1/8	30.65	24.00	0.0506	
132	08/02/88	TUNGS-CARB.	69.7018	0.6096	1X2X1/8	30.65	24.00	0.3263	
** ELECTROCHEMICALS		ELECTROSTRIP S.A.							
22	06/15/88	8740	31.1481	0.0174	1X2X1/8	30.65	1.00	0.0284	
19	06/15/88	9310	31.2364	0.0177	1X2X1/8	30.65	1.00	0.0253	
21	06/15/88	A286	14.8134	0.1538	1X2X1/16	27.91	1.00	0.2746	
27	06/14/88	C4340	28.5450	0.0141	1X2X1/16	27.91	1.00	0.0254	
29	06/14/88	CADMIUM	14.3831	7.5996	1X2X1/16	27.91	0.50	24.7864	
18	06/15/88	CDA 101	30.2487	3.3901	1X2X1/8	30.65	1.00	4.8982	
23	06/15/88	CHROMIUM	23.5745	0.5135	1X2X1/8	30.65	1.00	0.9173	
26	06/14/88	INDIUM	15.6266	0.2303	1X2X1/16	27.91	0.50	0.8899	
28	06/14/88	LEAD	22.7421	8.2582	1X2X1/16	27.91	1.00	10.2185	
25	06/14/88	NI200	30.1669	0.2841	1X2X1/8	30.65	1.00	0.4104	
20	06/14/88	SILVER	37.0871	6.5214	1X2X1/8	30.65	1.00	7.9779	
24	06/15/88	TIN	23.9619	2.4041	1X2X1/8	30.65	1.00	4.2302	

** ELECTROCHEMICALS		NICKEL-SOL						
311	09/21/88	17-4 PH	28.9735	-0.0001	1X2X1/8	30.65	24.16	0.0000 BDL
308	09/21/88	309 SS	28.8037	0.0003	1X2X1/8	30.65	24.40	0.0000 BDL
307	09/21/88	316 SS	29.3972	0.0004	1X2X1/8	30.65	24.31	0.0000 BDL
312	09/21/88	410 SS	26.1974	0.0052	1X2X1/8	30.65	14.25	0.0006
309	09/21/88	A286	14.3680	0.0003	1X2X1/16	27.91	24.48	0.0000 BDL
310	09/21/88	AL 1100	8.6726	0.4927	1X2X1/8	30.65	24.46	0.0955
302	09/21/88	BRONZE, FUMING	3.7796	3.7796	4.04" ROD	7.70	1.75	12.5461
306	09/21/88	C4340	28.6177	2.6095	1X2X1/8	30.65	4.50	0.9501
305	09/21/88	CADMIUM	11.2991	11.2991	1X2X1/16	27.91	1.50	12.2841
304	09/21/88	CDA 101	29.8784	14.4395	1X2X1/8	30.65	1.75	11.9220
303	09/21/88	NI200	32.3818	8.9245	1X2X1/8	30.65	4.50	2.8655
301	09/21/88	TUNGS-CARB.	70.2857	0.2626	1X2X1/4	36.12	3.50	0.8178
** FREDRICK GUMM CHEM.		CLEPO 204 (IMMERSION)						
189	08/09/88	17-4 PH	29.0781	0.0001	1X2X1/8	30.65	49.00	0.0000 BDL
188	08/09/88	8740	31.1218	0.0004	1X2X1/8	30.65	25.00	0.0000 BDL
187	08/09/88	A286	14.5188	0.0004	1X2X1/16	27.91	25.00	0.0000 BDL
184	08/09/88	BRONZE, FUMING	3.6937	0.4428	3.95" ROD	7.53	6.50	0.4049
186	08/09/88	C4340	28.5433	0.0006	1X2X1/8	30.65	25.00	0.0000 BDL
121	08/05/88	CADMIUM	13.1189	2.9885	1X2X1/16	27.91	1.08	4.5125
185	08/09/88	CDA 101	29.7309	0.1222	1X2X1/8	30.65	6.50	0.0272
122	08/05/88	INDIUM	15.3590	0.0360	1X2X1/16	27.91	2.16	0.0322
123	08/05/88	NI200	33.6743	0.8739	1X2X1/8	30.65	2.33	0.5419
124	08/05/88	SILVER	34.6013	0.0005	1X2X1/8	30.65	4.00	0.0000 BDL
126	08/05/88	TIN	24.4595	0.0180	1X2X1/8	30.65	5.00	0.0063
125	08/05/88	TUNGS-CARB.	70.7174	0.2013	1X2X1/8	30.65	5.00	0.5171
** FREDRICK GUMM CHEM.		CLEPO ELECTROSTRIP B/C						
149	06/21/88	17-4 PH	28.6038	0.2625	1X2X1/8	30.65	1.00	0.4323
148	06/21/88	8740	31.2200	0.0212	1X2X1/8	30.65	1.00	0.0347
151	06/21/88	9310	31.0513	0.0091	1X2X1/8	30.65	1.00	0.0130
153	06/21/88	A286	14.5253	0.0032	1X2X1/16	27.91	1.00	0.0057
152	06/21/88	C4340	28.4375	0.0273	1X2X1/8	30.65	1.00	0.0448
30	06/17/88	CADMIUM	14.4478	0.6143	1X2X1/16	27.91	1.00	1.0017
44	06/17/88	CDA 101	29.9710	1.6459	1X2X1/8	30.65	1.00	2.3781
31	06/17/88	CHROMIUM	23.1188	0.2577	1X2X1/8	30.65	1.00	0.4603
34	06/17/88	INDIUM	15.5998	0.1400	1X2X1/16	27.91	1.00	0.2705
32	06/17/88	LEAD	22.6295	2.3395	1X2X1/16	27.91	1.00	2.8948

	33	06/17/88	NI200	30.4459	0.1366	1X2X1/8	30.65	1.00	0.1973	
**	HNO3		HNO3							
	81	05/11/88	309 SS	30.0218	-0.0001	1X2X1/8	30.65	24.00	0.0000	BDL
	83	05/02/88	410 SS	26.9795	0.0010	1X2X1/8	30.65	24.00	0.0001	
	82	05/04/88	9310	30.4279	0.0300	1X2X1/8	30.65	53.00	0.0008	
	120	05/11/88	A286	14.4211	0.0000	1X2X1/16	27.91	24.00	0.0000	BDL
	79	05/04/88	C276	33.0075	0.0036	1X2X1/8	30.65	53.00	0.0001	
	80	05/11/88	C4340	28.5565	-0.0002	1X2X1/8	30.65	24.00	0.0000	BDL
	84	05/02/88	HASTELOY X	32.1947	0.0016	1X2X1/8	30.65	25.00	0.0001	
	85	05/03/88	INCONEL 625	32.5410	0.0017	1X2X1/8	30.65	24.00	0.0001	
**	KIESOW INT'L CORP.		NICKEL STRIPPER ST							
	35	05/19/88	17-4 PH	28.7836	-0.0018	1X2X1/8	30.65	24.00	0.0000	
	39	05/19/88	316 SS	29.4021	-0.0009	1X2X1/8	30.65	24.00	0.0000	
	43	05/27/88	8740	30.9708	0.0032	1X2X1/8	30.65	1.00	0.0052	
	50	06/02/88	8740	30.9700	0.0080	1X2X1/8	30.65	2.00	0.0066	
	47	05/27/88	9310	30.6980	0.0012	1X2X1/8	30.65	1.00	0.0017	
	49	06/02/88	9310	30.8664	0.0076	1X2X1/8	30.65	2.00	0.0054	
	37	05/19/88	A286	14.5113	-0.0001	1X2X1/16	27.91	24.00	0.0000	BDL
	46	05/27/88	A286	14.3815	0.0021	1X2X1/16	27.91	1.00	0.0038	
	52	06/02/88	A286	14.5466	0.0011	1X2X1/16	27.91	2.00	0.0010	
	53	06/07/88	C4340	28.8707	0.0038	1X2X1/8	30.65	5.00	0.0012	
	42	05/27/88	CADMIUM	13.6050	0.2003	1X2X1/16	27.91	1.00	0.3266	
	45	06/02/88	CADMIUM	14.7897	0.2896	1X2X1/16	27.91	2.00	0.2361	
	388	06/07/88	INDIUM	15.9911	2.2646	1X2X1/16	27.91	0.58	7.5449	
	36	05/19/88	LEAD	22.6232	-0.0002	1X2X1/16	27.91	24.00	0.0000	BDL
	40	05/27/88	LEAD	22.6867	0.4728	1X2X1/16	27.91	1.00	0.5851	
	41	06/02/88	LEAD	22.6600	15.4866	1X2X1/16	27.91	2.00	9.5814	
	38	05/19/88	NI200	30.1175	0.0006	1X2X1/8	30.65	24.00	0.0000	BDL
	48	05/27/88	NI200	30.0456	0.0015	1X2X1/8	30.65	1.00	0.0022	
	51	06/02/88	NI200	30.0140	0.0738	1X2X1/8	30.65	2.00	0.0534	
	389	06/07/88	SILVER	37.8110	9.1983	1X2X1/8	30.65	0.33	34.0988	
**	MACDERMID INC.		METEX NICKEL STRIPPER SCB							
	202	08/30/88	17-4 PH	28.7710	0.0006	1X2X1/8	30.65	25.16	0.0000	BDL
	210	08/29/88	9310	30.6872	0.0001	1X2X1/8	30.65	25.17	0.0000	BDL
	209	08/29/88	A286	14.4601	0.0003	1X2X1/16	27.91	1.40	0.0000	BDL
	207	08/29/88	BRONZE, FUMING	3.7514	0.0022	4.01" ROD	7.64	1.00	0.0129	
	212	08/29/88	C4340	28.5564	0.0005	1X2X1/8	30.65	24.00	0.0000	BDL

	203	08/31/88	CADMIUM	9.6205	0.2672	1X2X1/16	27.91	0.33	1.3204
	208	08/29/88	CDA 101	30.2724	0.0072	1X2X1/8	30.65	2.33	0.0044
	205	08/31/88	INDIUM	15.5184	0.0049	1X2X1/16	27.91	4.33	0.0022
	211	08/29/88	NI200	30.0181	0.0001	1X2X1/8	30.65	25.33	0.0000 BDL
	204	08/31/88	TIN	24.4901	3.3325	1X2X1/8	30.65	7.47	0.7850
	206	08/31/88	TUNGS-CARB.	56.4449	0.1753	1X2X1/8	30.65	7.33	0.3072
**	MACDERMID INC.		METEX SILVER STRIPPER CB						
	318	09/26/88	17-4 PH	28.3201	0.0046	1X2X1/8	30.65	24.10	0.0003
	316	09/26/88	BRONZE, FUMING	3.7685	0.5811	4.03" ROD	7.68	23.88	0.1418
	315	09/26/88	C4340	28.8264	0.0377	1X2X1/8	30.65	24.18	0.0026
	317	09/26/88	CDA 101	19.6752	0.1589	1X2X1/8	30.65	23.98	0.0096
	313	09/26/88	NI200	29.9933	0.2131	1X2X1/8	30.65	2.66	0.1158
	314	09/26/88	SILVER	33.5961	6.5127	1X2X1/8	30.65	2.90	2.7473
**	METALLINE CHEM CORP.		6400 (NI)						
	218	08/27/88	17-4 PH	28.2105	0.0008	1X2X1/8	30.65	24.00	0.0000 BDL
	395	11/02/88	8740	30.6340	0.0007	1X2X1/8	30.65	24.08	0.0000 BDL
	398	11/02/88	9310	31.1893	0.0004	1X2X1/8	30.65	24.00	0.0000 BDL
	216	08/27/88	A286	14.2770	0.0002	1X2X1/16	27.91	24.00	0.0000 BDL
	215	08/27/88	BRONZE, FUMING	4.8097	0.2515	5.14" ROD	9.78	24.00	0.0480
	217	08/27/88	C4340	28.7640	0.0002	1X2X1/8	30.65	24.00	0.0000 BDL
	214	08/26/88	CADMIUM	11.6105	0.3115	1X2X1/16	27.91	3.00	0.1693
	397	11/02/88	CADMIUM	9.1982	0.5852	1X2X1/16	27.91	6.10	0.1564
	213	08/26/88	NI200	30.1909	0.2838	1X2X1/8	30.65	1.00	0.4101
	396	11/02/88	NI200	29.0725	0.4408	1X2X1/8	30.65	1.63	0.3907
**	METALLINE CHEM CORP.		STRIPPER 672						
	267	09/08/88	17-4 PH	28.9746	0.0009	1X2X1/8	30.65	26.50	0.0001
	268	09/08/88	410 SS	26.2351	0.0006	1X2X1/8	30.65	26.08	0.0000 BDL
	266	09/08/88	9310	59.6342	0.0012	1X2X1/4	36.12	26.57	0.0001
	270	09/08/88	BRONZE, FUMING	4.5598	0.1265	4.87" ROD	9.27	26.08	0.0234
	269	09/08/88	C4340	28.5676	0.0015	1X2X1/8	30.65	26.28	0.0001
	275	09/08/88	CADMIUM	9.8863	0.0166	1X2X1/16	27.91	7.67	0.0035
	265	09/08/88	CDA 101	29.6324	3.0141	1X2X1/8	30.65	26.67	0.1633
	272	09/08/88	CHROMIUM	23.4941	-0.0001	1X2X1/8	30.65	7.25	0.0000 BDL
	271	09/08/88	LEAD	20.1849	3.6276	1X2X1/8	30.65	7.33	0.5576
	274	09/08/88	NI200	29.9936	0.0003	1X2X1/8	30.65	23.00	0.0000 BDL
	273	09/08/88	TIN	24.6978	7.4984	1X2X1/8	30.65	7.25	1.8199
	276	09/08/88	TUNGS-CARB.	69.6536	0.0042	1X2X1/4	36.12	7.50	0.0061

**	METALLINE CHEM CORP.		ZINC STRIPPER						
	279	09/12/88	17-4 PH	27.9446	0.0002	1X2X1/8	30.65	25.41	0.0000 BDL
	277	09/12/88	410 SS	26.9788	0.0000	1X2X1/8	30.65	25.33	0.0000 BDL
	280	09/12/88	9310	31.1508	0.0004	1X2X1/8	30.65	25.50	0.0000 BDL
	282	09/12/88	BRONZE, FUMING	3.8299	0.0022	4.09" ROD	7.80	25.70	0 0005
	278	09/12/88	C4340	28.3723	0.0004	1X2X1/8	30.65	25.00	0.0000 BDL
	288	09/13/88	CADMIUM	13.1049	0.0005	1X2X1/16	27.91	6.00	0.0000 BDL
	281	09/12/88	CDA 101	29.8922	0.0103	1X2X1/8	30.65	25.20	0.0006
	285	09/13/88	CHROMIUM	22.7962	0.0000	1X2X1/8	30.65	6.08	0.0000 BDL
	286	09/13/88	INCONEL 625	16.0469	0.0025	1X2X1/16	27.91	5.91	0.0007
	284	09/13/88	NI200	29.1092	-0.0001	1X2X1/8	30.65	5.66	0.0000 BDL
	287	09/13/88	TIN	13.2432	0.0573	1X2X1/16	27.91	5.83	0.0190
	283	09/13/88	TUNGS-CARB.	69.4113	0.0023	1X2X1/4	36.12	5.66	0.0044
**	OAKITE PRODUCTS, INC		STRIPPER Q9						
	414	12/08/88	410 SS	14.5218	0.0066	1X2X1/16	27.91	24.00	0.0005
	411	12/08/88	SILVER	23.1569	0.1153	1X2X1/16	27.91	0.75	0.2065
**	OMI INT'L CORP.		OXYSTRIP 6000						
	361	09/19/88	17-4 PH	29.0777	0.1040	1X2X1/8	30.65	26.00	0.0066
	367	09/20/88	309 SS	29.5132	4.0942	1X2X1/8	30.65	5.91	1.1264
	360	09/19/88	410 SS	26.2346	0.0075	1X2X1/8	30.65	26.10	0.0005
	362	09/19/88	9310	30.7859	0.0680	1X2X1/8	30.65	26.00	0.0037
	359	09/19/88	A286	14.5186	0.0022	1X2X1/16	27.91	18.00	0.0002
	368	09/20/88	AL 1100	8.9020	0.0251	1X2X1/8	30.65	1.33	0.0895
	369	09/20/88	BRONZE, FUMING	3.8172	1.7887	4.08" ROD	7.78	1.33	7.7364
	358	09/19/88	C4340	28.5430	0.0561	1X2X1/8	30.65	18.00	0.0051
	363	09/19/88	CADMIUM	12.7136	11.3480	1X2X1/16	27.91	25.75	0.7187
	364	09/20/88	CHROMIUM	23.4944	0.7777	1X2X1/8	30.65	1.33	1.0446
	365	09/20/88	NI200	32.4293	8.5491	1X2X1/8	30.65	5.50	2.2459
	366	09/20/88	TUNGS-CARB.	66.7847	2.3113	1X2X1/4	36.12	5.50	4.5805
**	OMI INT'L CORP.		UDYSTRIP 406						
	349	09/15/88	17-4 PH	28.2091	2.5527	1X2X1/8	30.65	25.28	0.1663
	348	09/15/88	410 SS	27.4789	5.6841	1X2X1/8	30.65	28.75	0.3298
	350	09/15/88	9310	30.6871	2.6326	1X2X1/8	30.65	29.01	0.1300
	352	09/15/88	BRONZE, FUMING	3.7087	1.0008	3.96" ROD	7.56	28.50	0.2078
	347	09/15/88	C4340	28.5559	5.6081	1X2X1/8	30.65	28.50	0.3224
	353	09/16/88	CADMIUM	19.7739	2.7437	1X2X1/8	30.65	5.25	0.7761

351	09/15/88	CDA 101	30.2519	0.0137	1X2X1/8	30.65	28.91	0.0007	
354	09/16/88	CHROMIUM	20.5905	0.0004	1X2X1/8	30.65	5.58	0.0000	BDL
355	09/16/88	NI200	30.0181	3.5347	1X2X1/8	30.65	5.50	0.9286	
356	09/16/88	SILVER	31.3532	0.0015	1X2X1/8	30.65	5.93	0.0003	
357	09/16/88	TUNGS-CARB.	56.2696	0.0653	1X2X1/4	36.12	5.85	0.1217	
** OMI INT'L CORP.		UDYSTRIP 460							
222	08/20/88	17-4 PH	29.0353	0.0009	1X2X1/8	30.65	24.00	0.0001	
219	08/20/88	309 SS	28.8034	0.0001	1X2X1/8	30.65	24.00	0.0000	BDL
221	08/20/88	8740	31.0263	0.0000	1X2X1/8	30.65	24.00	0.0000	BDL
220	08/20/88	9310	30.7859	0.0003	1X2X1/8	30.65	24.00	0.0000	BDL
223	08/20/88	A286	14.5095	-0.0002	1X2X1/16	27.91	24.00	0.0000	BDL
228	08/25/88	BRONZE, FUMING	3.8566	0.0019	4.12" ROD	7.86	6.00	0.0018	
224	08/20/88	C4340	27.2902	0.0009	1X2X1/8	30.65	24.00	0.0001	
229	08/25/88	CADMIUM	9.3839	2.6728	1X2X1/16	27.91	2.50	1.7435	
227	08/25/88	CDA 101	18.4581	0.1189	1X2X1/16	27.91	2.00	0.0943	
226	08/25/88	NI200	29.1100	0.0009	1X2X1/8	30.65	6.00	0.0002	
225	08/25/88	TIN	13.4531	0.2102	1X2X1/16	27.91	6.08	0.0668	
230	08/25/88	TUNGS-CARB.	68.9099	0.0124	1X2X1/8	30.65	6.00	0.0265	
** OMI INT'L CORP.		UDYSTRIP 7000							
345	09/22/88	17-4 PH	28.5652	0.0035	1X2X1/8	30.65	23.23	0.0002	
343	09/22/88	309 SS	28.2811	0.0175	1X2X1/8	30.65	23.43	0.0012	
346	09/22/88	410 SS	27.7005	0.0039	1X2X1/8	30.65	23.51	0.0003	
341	09/22/88	8740	31.1214	0.0422	1X2X1/8	30.65	23.75	0.0029	
342	09/22/88	9310	30.8531	0.0422	1X2X1/8	30.65	23.75	0.0025	
338	09/22/88	BRONZE, FUMING	3.7939	0.0732	4.05" ROD	7.73	2.00	0.2119	
344	09/22/88	C4340	28.5667	0.0293	1X2X1/8	30.65	6.02	0.0080	
336	09/22/88	CADMIUM	12.6860	6.6165	1X2X1/16	27.91	1.50	7.1933	
337	09/22/88	CDA 101	29.5514	0.9366	1X2X1/8	30.65	2.00	0.6766	
340	09/22/88	NI200	32.6890	0.1246	1X2X1/8	30.65	2.25	0.0800	
339	09/22/88	TUNGS-CARB.	69.4081	1.4626	1X2X1/4	36.12	2.25	7.0854	
** OMI INT'L CORP.		UDYSTRIP XPS-306							
233	08/20/88	17-4 PH	27.9447	0.0001	1X2X1/8	30.65	24.00	0.0000	BDL
231	08/20/88	309 SS	29.5134	0.0003	1X2X1/8	30.65	24.00	0.0000	BDL
232	08/20/88	8740	24.7801	0.0007	1X2X1/8	30.65	24.00	0.0000	BDL
235	08/20/98	9310	31.1507	0.0001	1X2X1/8	30.65	24.00	0.0000	BDL
234	08/20/88	A286	14.2906	0.0001	1X2X1/16	27.91	24.00	0.0000	BDL
240	08/23/88	BRONZE, FUMING	4.7889	0.0313	5.12" ROD	9.73	5.91	0.0243	

	236	08/20/88	C4340	28.3723	-0.0015	1X2X1/8	30.65	24.00	0.0000
	239	08/23/88	CADMIUM	9.9810	0.0955	1X2X1/16	27.91	1.00	0.1557
	242	08/23/88	CDA 101	19.8482	0.0407	1X2X1/16	27.91	6.00	0.0108
	238	08/23/88	NI200	33.0824	0.9928	1X2X1/8	30.65	1.00	1.4345
	241	08/23/88	TIN	23.3389	0.1918	1X2X1/8	30.65	6.00	0.0562
	237	08/23/88	TUNGS-CARB.	70.5173	0.1929	1X2X1/8	30.65	4.00	0.6195
**	PATCLIN		DIP N STRIP III						
	252	08/27/88	17-4 PH	28.3206	0.0001	1X2X1/8	30.65	24.00	0.0000 BDL
	251	08/27/88	8740	30.8680	-0.0001	1X2X1/8	30.65	24.00	0.0000 BDL
	250	08/27/88	9310	30.8531	0.0000	1X2X1/8	30.65	24.00	0.0000 BDL
	249	08/27/88	A286	14.3681	0.0000	1X2X1/16	27.91	24.00	0.0000 BDL
	245	08/29/88	BRONZE, FUMING	4.8359	0.0784	5.17" ROD	9.83	2.00	0.1784
	248	08/27/88	C4340	28.8268	0.0004	1X2X1/8	30.65	24.00	0.0000 BDL
	243	08/29/88	CADMIUM	7.9012	1.4710	1X2X1/16	27.91	6.00	0.3998
	246	08/29/88	CDA 101	28.4620	0.1024	1X2X1/8	30.65	1.00	0.1480
	244	08/29/88	NI200	29.5388	0.1115	1X2X1/8	30.65	3.00	0.0537
	247	08/29/88	TUNGS-CARB.	69.3513	0.0640	1X2X1/8	30.65	3.00	0.2740
**	PATCLIN		PATSTRIP NI						
	296	09/13/88	17-4 PH	29.0355	1.8093	1X2X1/8	30.65	24.90	0.1197
	299	09/13/88	309 SS	30.0220	6.6102	1X2X1/8	30.65	25.16	0.4272
	298	09/13/88	410 SS	26.7885	5.0451	1X2X1/8	30.65	25.16	0.3345
	300	09/13/88	BRONZE, FUMING	3.4529	0.0001	3.69" ROD	7.04	24.75	0.0000 BDL
	297	09/13/88	C4340	27.2894	3.5639	1X2X1/8	30.65	25.00	0.2336
	293	09/14/88	CADMIUM	12.8907	8.9064	1X2X1/16	27.91	4.50	3.2276
	295	09/13/88	CDA 101	29.5848	0.0000	1X2X1/8	30.65	25.16	0.0000 BDL
	290	09/14/88	CHROMIUM	23.0782	0.0004	1X2X1/8	30.65	4.75	0.0000 BDL
	292	09/14/88	NI200	29.9350	3.8982	1X2X1/8	30.65	5.00	1.1265
	289	09/14/88	SILVER	34.6007	0.0005	1X2X1/8	30.65	4.58	0.0000 BDL
	294	09/14/88	TIN	23.1473	15.1312	1X2X1/16	27.91	4.58	6.3840
	291	09/14/88	TUNGS-CARB.	68.8972	0.0663	1X2X1/4	36.12	4.58	0.1578
**	PATCLIN		PATSTRIP NI-E						
	256	09/01/88	17-4 PH	28.8758	21.8258	1X2X1/8	30.65	26.25	1.3692
	255	09/01/88	410 SS	27.3968	1.2059	1X2X1/8	30.65	26.08	0.0771
	258	09/01/88	8740	60.2936	0.0704	1X2X1/4	36.12	2.33	0.0420
	253	09/01/88	9310	30.3770	0.0663	1X2X1/8	30.65	25.83	0.0037
	257	09/01/88	A286	14.4428	1.0978	1X2X1/16	27.91	26.16	0.0749
	259	09/06/88	BRONZE, FUMING	3.7594	2.8643	4.02" ROD	7.66	1.67	10.0163

	254	09/01/88	C4340	28.2560	0.0529	1X2X1/8	30.65	26.00	0.0033
	260	09/06/88	CADMIUM	8.3580	5.5739	1X2X1/16	27.91	2.05	4.4340
	262	09/06/88	CDA 101	28.2798	18.3849	1X2X1/8	30.65	2.33	11.4009
	261	09/06/88	CHROMIUM	22.9416	0.0040	1X2X1/8	30.65	1.90	0.0037
	263	09/06/88	NI200	29.3594	0.2132	1X2X1/8	30.65	2.25	0.1369
	264	09/06/88	TUNGS-CARB.	69.2881	2.4695	1X2X1/4	36.12	2.67	10.0813
**	PATCLIN		PATSTRIP NIX-85						
	332	09/29/88	17-4 PH	27.9445	-0.0083	1X2X1/8	30.65	24.12	0.0000
	56	05/16/88	309 SS	29.5224	0.0005	1X2X1/8	30.65	25.00	0.0000 BDL
	8	05/17/88	316 SS	29.4117	0.0003	1X2X1/8	30.65	24.00	0.0000 BDL
	54	05/16/88	410 SS	26.7891	0.0009	1X2X1/8	30.65	25.00	0.0001
	119	05/16/88	8740	30.6498	0.0001	1X2X1/8	30.65	25.00	0.0000 BDL
	55	05/16/88	9310	30.8544	-0.0003	1X2X1/8	30.65	25.00	0.0000 BDL
	330	09/29/88	9310	31.1504	-0.0009	1X2X1/8	30.65	23.92	0.0000
	7	05/17/88	A286	14.4365	0.0002	1X2X1/16	27.91	24.00	0.0000 BDL
	334	09/29/88	BRONZE, FUMING	3.7602	0.0101	4.02" ROD	7.66	24.15	0.0024
	405	11/09/88	BRONZE, FUMING	3.7737	0.0776	4.00" ROD	7.69	23.00	0.0196
	406	11/09/88	BRONZE, FUMING	2.8145	0.0141	3.00" ROD	5.76	5.03	0.0218
	407	11/09/88	BRONZE, FUMING	2.8017	0.1246	3.00" ROD	5.73	22.40	0.0434
	118	05/16/88	C4340	30.6505	2.1066	1X2X1/8	30.65	25.00	0.1381
	333	09/29/88	C4340	28.3716	0.0001	1X2X1/8	30.65	24.12	0.0000 BDL
	408	11/09/88	C4340	28.3338	3.0000	1X2X1/16	27.91	23.33	0.2314
	335	09/29/88	CDA 101	29.4029	0.7691	1X2X1/8	30.65	23.92	0.0465
	57	05/16/88	HASTELOY X	32.3743	0.0008	1X2X1/8	30.65	25.00	0.0000 BDL
	331	09/29/88	NI200	29.8887	2.7744	1X2X1/8	30.65	18.10	0.2215
	409	11/10/88	NI200	31.4957	1.0971	1X2X1/8	30.65	0.00	**********
**	WITCO CORP.		ARP-60						
	64	06/13/88	8740	31.0346	4.9564	1X2X1/8	30.65	0.67	12.1048
	68	06/13/88	9310	31.1235	1.1635	1X2X1/8	30.65	0.50	3.3322
	67	06/13/88	A286	14.8815	0.0007	1X2X1/16	27.91	0.50	0.0000 BDL
	60	06/10/88	C4340	28.4966	6.3881	1X2X1/8	30.65	1.00	10.4662
	66	06/13/88	CDA 101	30.0997	0.0044	1X2X1/8	30.65	0.50	0.0128
	58	06/10/88	INDIUM	15.6954	4.7765	1X2X1/16	27.91	1.00	9.2299
	61	06/10/88	LEAD	22.6958	0.0008	1X2X1/16	27.91	1.00	0.0000 BDL
	63	06/10/88	NI200	30.6384	0.0007	1X2X1/8	30.65	1.00	0.0000 BDL
	62	06/10/88	SILVER	37.0885	0.0010	1X2X1/8	30.65	1.00	0.0012
	65	06/13/88	TIN	24.8075	5.2904	1X2X1/8	30.65	0.58	16.0499

** WITCO CORP. ARP-66

75	06/09/88	17-4 PH	27.9590	0.0005	1X2X1/8	30.65	6.00	0.0000 BDL
77	06/09/88	309 SS	28.8287	0.0002	1X2X1/8	30.65	6.00	0.0000 BDL
76	06/09/88	8740	30.9492	0.0001	1X2X1/8	30.65	6.00	0.0000 BDL
69	06/09/88	9310	31.1776	0.0001	1X2X1/8	30.65	6.00	0.0000 BDL
78	06/09/88	A286	14.3025	0.0002	1X2X1/16	27.91	6.00	0.0000 BDL
399	11/15/88	BRONZE, FUMING	3.3952	0.8407	3.63" ROD	6.93	24.45	0.2221
74	06/08/88	C4340	28.7966	0.0012	1X2X1/8	30.65	4.00	0.0005
402	11/15/88	C4340	28.7098	0.0008	1X2X1/8	30.65	24.90	0.0000 BDL
403	11/15/88	C4340	28.7765	0.0002	1X2X1/8	30.65	25.22	0.0000 BDL
145	06/08/88	CADMIUM	14.7763	1.8615	1X2X1/16	27.91	4.00	0.7589
71	06/08/88	CDA 101	29.7227	0.0015	1X2X1/8	30.65	4.00	0.0005
400	11/15/88	CDA 101	27.4097	0.7515	1X2X1/8	30.65	24.62	0.0441
401	11/15/88	CDA 101	27.6526	0.8191	1X2X1/8	30.65	24.00	0.0493
70	06/08/88	INDIUM	16.0813	0.0636	1X2X1/16	27.91	4.00	0.0307
72	06/08/88	LEAD	22.5208	0.3159	1X2X1/16	27.91	4.00	0.0977
73	06/08/88	NI200	30.8463	1.4769	1X2X1/8	30.65	4.00	0.5335
404	11/15/88	NI200	29.1159	0.0005	1X2X1/8	30.65	5.05	0.0000 BDL

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APPENDIX D

COUPON ANALYSIS

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NON CYANIDE

STRIPPERS

RECORD	DATE	MATERIAL	
** CIRCUIT CHEM. CORP.			CIRSTRIP NCN-CU A,B
410	/ /		
5	05/19/81	7-4 PH	BLUE PURPLE COLORATIONS AROUND UPPER FRONT AND BACK SURFACE OF THE COUPON. YELLOW OPAQUE FILM COVERS THE REMAINING SURFACE LOOKS LIKE CRACKS ON SURFACE (SHORT HORIZONTAL 0.0005 INCHES LONG. CANNOT DETERMINE THE DEPTH. THESE CRACKS ARE OFFSET. THERE ARE NO VERTICAL ONES.) NO PITS OR ATTACK AT SURFACE DEFECTS.
328	09/28/88	17-4 PH	
16	05/18/88	309 SS	SURFACE LOOKS LIKE ORIGINAL. AREA OF GENERAL CORROSION AT TOP END OF THE COUPON ON THE FRONT SURFACE.
3	05/19/88	316 SS	YELLOW COLORATIONS ON FRONT AND BACK SURFACES AROUND EDGE OF COUPON RANGING FROM 1/16 INCHES INWARD TO 3/4 INCHES AT TOP. SPOTTED YELLOW COLORATIONS COVERING REMAINING SURFACE. NO PITS.
381	/ /	410 SS	
327	09/28/88	410 SS	
382	10/19/88	410 SS	
326	09/28/88	8740	
385	10/19/88	8740	
386	10/19/88	8740	
387	10/19/88	8740	
15	05/18/88	9310	AREAS OF SEVERE CORROSION AROUND HOLE. ALSO LARGE AREA COVERING 1/2 X 3/4 INCHES ON THE LOWER RIGHT SURFACE OF THE BACK OF THE COUPON ON THE RIGHT TOP FRONT SURFACE IS CORRODED (3/16X3/16 INCHES) ENTIRE SURFACE IS PITTED, APPROXIMATELY 556 PITS. ALL PITS ARE CIRCULAR. DEPTH RANGE FROM 0.0002 INCHES TO 0.0034 INCHES, AVERAGE DEPTH IS 0.0006 INCHES.
325	09/28/88	9310	
383	10/19/88	9310	
384	10/19/88	9310	
6	05/19/88	A286	BLUE PURPLE COLORATIONS AROUND UPPER WIDTH RANGED FROM 0.0002 TO 0.0008 INCHES AVERAGE WIDTH WAS 0.0005 INCHES.
9	05/17/88	AL 1100	ENTIRE SURFACE COVERED WITH WHITE SCALE. SCALE IS RELATIVELY THIN. SOME CORROSION AT TOP OF HOLE. SCALE IS CRYSTALLINE UNDER MICROSCOPE. IMPOSSIBLE TO SEE THE METAL SURFACE THROUGH THE SCALE.
324	09/28/88	BRONZE, FU	METAL IS A WHITE-YELLOW COLOR, NO PITS.
390	10/21/88	BRONZE, FU	
12	05/17/88	C276	LIGHT ETCHING OF SURFACE, NO DEPTH, NO PITS.
17	05/18/88	C276	SURFACE HAS SCATTERED RUST SPOTS GENERAL CORROSION APPROXIMATELY 0.0006 INCHES IN

			DEPTH. AVERAGE DEPTH IS 0.0006 INCHES. MAXIMUM DEPTH IS 0.0014 INCHES. SOME AREA ARE RUST COVERED WITH NO DEPTH. RUST AREAS APPROXIMATELY 0.0012 INCREMENTS ACROSS OR ARE JUST LINES. NO PITS.
14	05/18/88	C4340	AREAS OF CORROSION AROUND HOLE AND AT 0 IN C4340. ALSO 3/8 INCHES FROM BOTTOM AND 3/8 INCHES FROM RIGHT SIDE SCATTERED RUST OVER ENTIRE SURFACE, SURFACE IS PITTED, 139 PITS, MOSTLY OBLONG, DEPTH RANGED FROM 0.0002 TO 0.0034 INCHES, MAXIMUM DEPTH IS 0.0034 INCHES, AVERAGE WIDTH IS 0.0002 INCHES. MAXIMUM WIDTH IS 0.0013 INCHES.
329	09/28/88	C4340	
320	09/28/88	CADMIUM	NO PITS. A LIGHT FILM OVER COUPON, LOOKS LIKE IT CORRODED PREVIOUSLY.
391	10/21/88	CADMIUM	
323	09/28/88	CDA 101	HAS BEEN REPOLISHED, NO PITS.
392	10/21/88	CDA 101	
10	05/17/88	CHROMIUM	NO PITS, SURFACE ETCHED LIGHTLY.
13	05/18/88	HASTELOY X	YELLOW BLUE TO PURPLE COLOR COVERS FRONT SURFACE AND BACK. COLORATIONS IS MORE BLOTCHY ON THE BACK, NO PITS, MAY BE SOME AREA OF LOCAL ATTACK: BUT THERE IS NO DEPTH, THESE MAY JUST BE DUE TO DEFECTS IN THE ORIGINAL SURFACE SUCH AS ROLLING.
11	05/17/88	INCONEL 62	ENTIRE SURFACE ETCHED LIGHTLY, NO DEPTH, NO PITS.
1	05/18/88	INCONEL 62	SPLOTCHY BROWN "RUST" COVERS FRONT SURFACE. SPLOTCHES ARE APPROXIMATELY 0.0015 INCHES IN DIAMETER. NO PITS. STREAKS OF RUST THROUGH CENTER OF COUPON LENGTHWISE BUT NO DEPTH.
322	09/28/88	INDIUM	COUPON LOOKS LIKE IT HAS BEEN SEVERELY CORRODED AND REPOLISHED. THE ORIGINAL SURFACE IS INSUFFICIENT FOR PIT DEPTH EXAMINATION.
394	10/21/88	INDIUM	
2	05/19/88	LEAD	GRAY FILM COVERS SURFACE. LOOKS RATHER THICK, LOOKS LIKE A DEFECT OR LINE (APPROXIMATE 3/8 INCHES LONG) IN ABOUT THE CENTER OF FRONT AT BOTTOM. GREEN FILM AROUND THE HOLE. BLACK TO GREEN FILM ALONG TOP OF BACK APPROXIMATELY 1/8 INCHES DOWN. SURFACE LOOKS CRYSTALLINE UNDER THE MICROSCOPE. NO PITS APPARENT, CANNOT SEE THE ROLLING GRAIN THROUGH THE FILM. SOME SCRATCHES ARE APPARENT.
4	05/19/88	NI200	SMOKY OPAQUE FILM COVERING BOTH SURFACES, NO PITS, A LOT OF AREAS OF INITIALS ROLLING DEFECTS, BUT NO APPARENT ATTACK.
393	10/21/88	NI200	
321	09/28/88	SILVER	SURFACE IS CRYSTALLINE WITHOUT MICROSCOPE EXAMINATION. NO PITS. ENTIRE SURFACE IS CRYSTALLINE. THERE IS NO INDICATION OF THE ORIGINAL ROLLING GRAINS.
319	09/28/88	TIN	SILVERY (POLISHED) SURFACE. NO PITS.

** CIRCUIT CHEM. CORP.			NICSTRIP NCN-SCB
198	08/11/88	17-4 PH	SURFACE LOOKS LIKE ITS ORIGINAL STATE. NO PITS.
199	08/11/88	309 SS	SURFACE LOOKS LIKE ITS ORIGINAL STATE. NO PITS.
197	08/11/88	A286	SURFACE LOOKS LIKE ITS ORIGINAL STATE. NO PITS.
190	08/11/88	BRONZE, FU	SURFACE LOOKS LIKE ITS ORIGINAL STATE. NO PITS.
196	08/11/88	C4340	SURFACE LOOKS LIKE ITS ORIGINAL STATE. NO PITS.
191	08/11/88	CADMIUM	COUPON IS THINNER THAN ORIGINALLY. THICK, BLACK SCALE COVERS SURFACE, UNIFORM CORROSION OVER SURFACE AT A DEPTH OF .00005 INCHES.
192	08/11/88	CDA 101	BROWN AND BLACK OXIDATION FOLLOWS THE GRAIN OF THE METAL, BUT HAS NO DEPTH, NO PITS.
193	08/11/88	LEAD	DISCOLORED, DARK GRAY, IN GENERAL LIGHT OXIDATION SCATTERED OVER SURFACE. UNIFORM CORROSION OVER SURFACE AT A DEPTH OF .0002 INCHES, HEAVIEST CORROSION IN MIDDLE OF BOTH SIDES.
194	08/11/88	NI200	APPROXIMATELY 26 PITS, DEPTH RANGE .0001 INCHES TO 0007 INCHES, AVERAGE DEPTH .0005 INCHES, WIDTH RANGE .004 INCHES TO .014 INCHES, AVERAGE WIDTH .008 INCHES. PITS ARE ROUND AND SCATTERED OVER SURFACE. REST OF SURFACE LOOKS LIKE ORIGINAL STATE.
195	08/11/88	SILVER	DISCOLORED, GRAY AND BROWN, IN GENERAL, LIGHT OXIDATION SCATTERED OVER SURFACE. ONE LAYER OF UNIFORM CORROSION AT A DEPTH OF .00034 INCHES, CORROSION TAKES THE FORM OF TROUGHS. ALSO TOO MANY PITS TO COUNT SCATTERED OVER SURFACE. DEPTH RANGE .00015 INCHES TO .00032 INCHES, AVERAGE DEPTH .00026 INCHES, WIDTH RANGE .006 INCHES TO .024 INCHES, AVERAGE WIDTH .018 INCHES, PITS ARE NOT ROUND.
200	08/11/88	TIN	SURFACE DULL WITH A LIGHT GREEN TINT TO IT. STRIP OF UNIFORM CORROSION DOWN CENTER OF FRONT AT A DEPTH OF .0002 INCHES, APPROXIMATELY 47 PITS BESIDES CORRODED STRIP, DEPTH RANGE .00012 INCHES TO .0002 INCHES, AVERAGE DEPTH .00012 INCHES, WIDTH RANGE .006 INCHES TO .0000010 INCHES, AVERAGE WIDTH .008 INCHES.
201	08/11/88	TUNGS-CARB	A STEEL GRAY COLOR, APPROXIMATELY 53 PITS, DEPTH RANGE .0001 INCHES TO .00025 INCHES, AVERAGE DEPTH .00017 INCHES, WIDTH RANGE .004 INCHES TO .010 INCHES, AVERAGE WIDTH .008 INCHES.
** CN			CN ELECTROLYTIC
86	07/08/88	17-4 PH	MIDDLE-BACK DISCOLORED ORANGE AND YELLOW. BLACK WHERE HUNG. FRONT HAS WHITE CRYSTALLINE SUBSTANCE SCATTERED OVER IT. NO PIT ANALYSIS POSSIBLE THROUGH WHITE COATING BECAUSE COATING

		ITSELF IS POCKMARKED.
158	07/12/88 17-4 PH	EDGES COLORED DARK BROWN AROUND HOLE. ON FRONT, CONCENTRIC SEMICIRCLES OF DISCOLORATION APPEAR. RINGS GET DARKER BROWN AS THEY PROCEED OUT FROM HOLE AND ARE RIMMED IN RED. BACK IS RED-BROWN. IN GENERAL, LIGHT OXIDATION OVER FRONT. ETCHING PRESENT IN DISCOLORED AREAS. NO PITS
161	07/13/88 17-4 PH	RUSTED AROUND HOLE, IN GENERAL, LIGHT OXIDATION SCATTERED OVER ALL. BACK COLOR WITH CIRCLES OF BLUE AND BROWN. LEVELS OF UNIFORM CORROSION APPARENT. FIRST LEVEL .0001 INCHES. BELOW ORIGINAL SURFACE. SECOND LEVEL .0004 INCHES BELOW ORIGINAL SURFACE. LEVELS ALTERNATE OVER SURFACE. NO PITS.
88	07/07/88 8740	THE LOWER 1/3 OF THE COUPON HAS A DARK GOLD TINT. THE UPPER 1/2 UNUNIFORMLY TINTED TO CLEAR WITH NO SURFACE DEFECTS. THE BACK IS UNIFORMLY COVERED WITH A DARK GOLD TINT.
157	07/12/88 8740	FRONT HAS A WATER STAIN DOWN RIGHT SIDE AND ACROSS BOTTOM. BACK COLORED WITH SPOTS OF BEIGE AND DARK GRAY. BLACK OXIDATION DOWN LEFT, FRONT SIDE. NO PITS.
163	07/13/88 8740	UPPER BACK CORRODED BUT NOT MUCH DEPTH. BACK IS BROWN AND ORANGE. FRONT COLORED BROWN WITH SCATTERED AREAS OF BLUE OXIDATION. NO PITS.
87	07/07/88 9310	THE COUPON HAS NO SURFACE DEFECTS ON PITTING AND HAS A DARK GOLD-BROWN COATING ABOUT 1/4 INCHES FROM THE BOTTOM OF THE FRONT. THE DARK GOLD COATING COVERS BOTH SIDES AND THE BOTTOM EDGE
156	07/12/88 9310	THE COUPON HAS A UNIFORM DULL GRAY COATING OVER THE ENTIRE SURFACE. IN GENERAL, LIGHT OXIDATION OVER SURFACE AND IS COLORED BLACK, BROWN, AND ORANGE. NO PITS
162	07/13/88 9310	EDGES ARE BLACK AND ORANGE. FRONT DISCOLORED WITH CONCENTRIC OBLONG RINGS THAT ARE FIRST BROWN, THEN ORANGE, YELLOW, BLUE, PURPLE, AND BROWN AGAIN. BACK IS PITTED AND PITS ARE BLACK. BOTTOM AND FRONT HAS SEVERE PITTING. UNIFORM DEPTH OF .0001 INCHES, WIDTH RANGE .002 INCHES TO .008 INCHES, AVERAGE WIDTH .0035 INCHES, TOO MANY PITS TO COUNT.
89	07/07/88 A286	THE COUPON IS COVERED ON THE FRONT WITH A LIGHT GOLD TINT THAT IS DARKER AROUND THE EDGES. THE BACK OF THE COUPON IS ALMOST CLEAN WITH THE GOLD TINT OBSERVED ON THE UPPER 1/4. THERE WAS NO PITTING OR SURFACE DEFECTS OBSERVED ON EITHER SIDE OF THE COUPON.
155	07/12/88 A286	FRONT COLORED BEIGE, GRAY, AND RED-BROWN, BOTTOM TWO-THIRDS OF BACK COLORED RED-BROWN, THEN A BEIGE STRIPE, THEN A GREEN STRIPE. IN GENERAL, LIGHT OXIDATION IS SCATTERED OVER FRONT. BEGINNINGS OF PITS ARE ALSO SCATTERED OVER FRONT. NO DEPTH BUT AREAS APPEAR ORANGE

			AND OFTEN BRIGHT RED. MOST PITS APPROXIMATELY 0001 INCHES WIDE.
160	07/13/88	A286	GENERAL, LIGHT OXIDATION SCATTERED OVER ALL. THE COUPON RUSTED AROUND HOLE BUT NO DEPTH. LIGHTLY ETCHED AROUND HOLE. NO PITS.
146	07/07/88	AL 1100	THE COUPONS FRONT SURFACE IS SPOTTED IN PLACES WITH SOME VERY LIGHT SCALE SPORADICALLY LOCATED ON THE SURFACE. THE BACKSIDE OF THE COUPON HAS NO SCALE BUT HAS A LIGHT GOLD TINT IN THE CENTER PORTION. THERE WAS NO OBSERVED PITTING ON EITHER SIDE OF THE COUPON.
170	07/18/88	BRONZE-FU	ROD IS ALMOST WORN THROUGH AT BEND WHERE IT WAS HUNG. AT THIS SAME POINT THERE ARE ORANGE AND BLUE RINGS OF DISCOLORATION. UNIFORM STRIPPING WITH NO PITS. ROD COVERED WITH BLACK COATING FROM OXIDATION AND SOME RUST UNDERNEATH THIS.
133	07/27/88	BRONZE-FU	ROD IN TWO PIECES WHICH ARE WORN VERY THIN. SLIGHT ORANGE DISCOLORATION. NO PITS. CORROSION APPEARS UNIFORM.
139	07/28/88	BRONZE-FU	UNIFORMLY CORRODED. NO PITS. BLACK WHERE HUNG. LIGHT OXIDATION TOWARD ENDS.
90	07/07/88	C4340	BLACK OXIDE COATING COVERS COUPON EXCEPT AROUND HOLE. SURFACE IS VISIBLE THROUGH COATING AND LOOKS GOOD. NO PITS.
154	07/12/88	C4340	FRONT OF COUPON COVERED WITH TRANSPARENT FILM WHICH REFLECTS VISIBLE LIGHT (COUPON APPEARS PURPLE, BLUE, GREEN, YELLOW, ETC.), EDGES ARE DARK GRAY. BACK COLORED BLUE AND GRAY. IN GENERAL, LIGHT OXIDATION SCATTERED OVER FRONT. ON BACK WHERE HUNG COUPON IS RUSTED.
171	07/13/88	C4340	BACK AND EDGES COLORED BROWN. FRONT DOWN LEFT SIDE AND ACROSS BOTTOM IS BROWN, ABOVE BROWN ARE THIN STRIPES OF RED, THEN YELLOW, GREEN, BLUE, AND PURPLE. SURFACE LOOKS LIKE ORIGINAL STATE OTHER THAN THE COLORING. NO PITS.
169	07/18/88	CADMIUM	COUPON IS NOW PAPER THIN. EDGES ARE THINNER THAN MIDDLE. DISCOLORED DARK GRAY AND BEIGE. SURFACE UNIFORMLY CORRODED WITH THOUSANDS OF PITS OF WIDTH .001 INCHES AND DEPTH .0002 INCHES. IN GENERAL LIGHT OXIDATION SCATTERED OVER SURFACE. PITS RUN TOGETHER AND THERE ARE TOO MANY TO COUNT.
134	07/27/88	CADMIUM	THE COUPON IS SHINY ON THE SIDE FACING AWAY FROM THE COUNTER ELECTRODE WITH NO PITTING OR SURFACE DEFECTS. DISCOLORED GRAY WITH AREAS OF LIGHT BROWN. MORE BROWN ON BACK. SURFACE UNIFORMLY CORRODED TO A DEPTH OF .00015 INCHES. CORROSION NOT IN FORM OF PITS.
140	07/28/88	CADMIUM	THE SIDE OF THE COUPON FACING THE COUNTER ELECTRODE IS CLEAN AND UNIFORMLY STRIPPED WITH UNIFORM PITTING. COUPON THIN WITH EDGES TAPERED WITH THREE APPARENT LEVELS OF UNIFORM CORROSION. FIRST .0003 INCHES DEEP. SECOND

			.0004 INCHES DEEP. THIRD .006 INCHES DEEP. LEVELS ALTERNATE OVER SURFACE. NO REAL PITS. BLACK AND ORANGE DISCOLORATION. BOTTOM EDGE CORRODED AWAY. CORROSION MOST NOTICEABLE AROUND HOLE AND WHERE HUNG.
373	10/06/88	CDA 101	
374	10/06/88	CDA 101	
375	10/06/88	CDA 101	
165	07/18/88	INDIUM	EDGES BLACK AND REST OF COUPON DISCOLORED DARK GRAY. IN GENERAL LIGHT OXIDATION SCATTERED OVER ALL. WHITE COATING WHERE HUNG AND COMES OFF AS A POWDER ON CONTACT. LEVELS OF UNIFORM CORROSION APPARENT. FIRST LEVEL .0005 INCHES DEEP. SECOND LEVEL .00072 INCHES DEEP. LEVELS ALTERNATE OVER SURFACE. NO REAL PITS.
135	07/27/88	INDIUM	THE COUPON IS SEVERELY PITTED ON THE SIDE FACING THE COUNTER ELECTRODE. ENDS WORN THIN. COUPON RED WHERE HUNG FRONT AND BACK. TOO MANY PITS TO COUNT. DEPTH RANGE .00015 INCHES TO .0005 INCHES, AVERAGE DEPTH .00024 INCHES, WIDTH RANGE .012 INCHES TO .02 INCHES AVERAGE WIDTH .014 INCHES. MANY OF THE PITS RUN INTO EACH OTHER. ORIGINAL SURFACE IS ETCHED.
143	07/28/88	INDIUM	BACK LOWER 3/4 IS BLACK. FRONT LOWER 1/3 IS BLACK. LIGHT, SCATTERED RUST SPOTS. NO PITS.
168	07/18/88	LEAD	DISCOLORED GRAY WITH YELLOW SPOTS. HOLE CORRODED ALL OF THE WAY THROUGH AT TOP. SEVERELY CORRODED WITH APPROXIMATELY 55 PITS. DEPTH RANGE .0012 INCHES TO .0022 INCHES, AVERAGE DEPTH .0020 INCHES, WIDTH RANGE .002 INCHES TO .004 INCHES, AVERAGE WIDTH .003 INCHES. ALSO LEVELS OF UNIFORM CORROSION ALTERNATE OVER SURFACE. FIRST LEVEL .0004 INCHES BELOW ORIGINAL SURFACE. SECOND LEVEL .0005 INCHES BELOW SURFACE. THIRD LEVEL .00075 INCHES BELOW CORROSION IN THE FORM OF TROUGHS OF WIDTH .002 INCHES.
137	07/27/88	LEAD	THE BOTTOM 1/2" AND 1/8" ALONG THE RIGHT SIDE IN THE AIR STREAM IS LIGHT GREEN AND SEVERELY PITTED ON SIDE AWAY FROM ELECTRODE. THE SIDE FACING THE ELECTRODE IS UNIFORMLY, SEVERELY PITTED. ABOVE HOLE COUPON IS WORN AND STRETCHED. FRONT DISCOLORED ORANGE, GREEN, AND BROWN. BACK IS RED AND GREEN, TOO MANY PITS TO COUNT. DEPTH .00015 INCHES TO .0008 INCHES, AVERAGE DEPTH .0005 INCHES, WIDTH 0.012 INCHES TO 0.032 INCHES, AVERAGE WIDTH 0.2 INCHES. PITS ARE OBLONG.
141	07/28/88	LEAD	COUPON THIN. FRONT DISCOLORED STEEL GRAY WITH AREAS OF YELLOW BROWN AND BLACK. YELLOW WHERE HUNG. BACK IS DARK GRAY AND ORANGE. SEVERELY PITTED. DEPTH RANGE .00035 INCHES TO .00088 INCHES, AVERAGE DEPTH .00074 INCHES,

			WIDTH RANGE 0.0079 INCHES TO 0.0168 INCHES, AVERAGE WIDTH 0.014 INCHES. TO MANY PITS TO COUNT.
166	07/18/88	NI200	AROUND HOLE GRAY, BROWN, AND BLUE SEMICIRCLES. IN GENERAL LIGHT OXIDATION SCATTERED OVER SURFACE. LIGHT ETCHING ACCOMPANIES OXIDATION. NO PITS.
138	07/27/88	NI200	COLORED PINK WHERE HUNG. SURFACE DISCOLORED GRAY, LIGHT BROWN, AND ORANGE. LIGHT SCATTERED OXIDATION. NO PITS.
142	07/28/88	NI200	COLORED BLACK AND ORANGE WHERE HUNG. SCATTERED AREAS OF LIGHT OXIDATION. SURFACE LOOKS LIKE ORIGINAL. NO PITS.
370	10/06/88	NI200	
371	10/06/88	NI200	
372	10/06/88	NI200	
167	07/18/88	SILVER	EDGES ARE THINNER THAN ORIGINAL. COUPON IS GOLD TINTED. CORROSION OVER SURFACE. NO PITS BUT TROUGHS. DEPTH RANGE .0003 INCHES TO .0015 INCHES, AVERAGE DEPTH .0010 INCHES, AVERAGE WIDTH .004 INCHES, IN GENERAL LIGHT OXIDATION OVER SURFACE, (BLACK).
136	07/27/88	SILVER	THE SIDE FACING THE COUNTER ELECTRODE IS SEVERELY CORRODED AND PITTED OVER THE ENTIRE SURFACE. BACK DISCOLORED YELLOW. PITTING OCCURS AT EDGES AND ALONG BOTTOM BACK. TO MANY PITS TO COUNT. DEPTH RANGE .00014 INCHES TO .0004 INCHES, AVERAGE DEPTH .0003 INCHES, WIDTH RANGE 0.004 INCHES TO .03 INCHES. MANY PITS RUN INTO EACH OTHER.
144	07/28/88	SILVER	THE SIDE OF THE COUPON FACING THE COUNTER ELECTRODE IS SEVERELY PITTED AND CORRODED. TO MANY PITS TO COUNT. DEPTH .00021 INCHES TO .00055 INCHES, AVERAGE DEPTH .00034 INCHES, WIDTH 0.007874 INCHES TO 0.015748 INCHES, AVERAGE WIDTH 0.011811 INCHES. PITS ARE GOLD INSIDE. MANY PITS RUN INTO EACH OTHER.
127	08/02/88	TUNGS-CARB	THE BACKSIDE OF THE COUPON FACING AWAY FROM THE COUNTER ELECTRODE IS CORRODED SEVERELY UP TO 1" FROM THE BOTTOM. THE FRONT OF THE COUPON ALSO CORRODED BADLY AND PITTED. TO MANY PITS TO COUNT. DEPTH RANGE .0004 INCHES TO .0102 INCHES, AVERAGE DEPTH .00030 INCHES, WIDTH RANGE 0.004 INCHES TO 0.04 INCHES, AVERAGE WIDTH 0.017 INCHES. DISCOLORED DARK GRAY. GENERAL, SCATTERED RUST OVER ORIGINAL SURFACE.
128	08/02/88	TUNGS-CARB	EDGES WORN THIN. DISCOLORED BLACK, BROWN, AND BLUE WHERE HUNG. BACK DISCOLORED WITH CONCENTRIC CIRCLES OF SHADES OF GRAY. FRONT - TOP HALF DARK GRAY, BOTTOM HALF LIGHT GRAY. TWO UNIFORM LAYERS OF CORROSION APPARENT. FIRST LAYER .0002 INCHES DEEP. SECOND LAYER .00035 INCHES DEEP. LAYERS ALTERNATE OVER SURFACE. GENERAL SCATTERED RUST SPOTS. NO

			PITS.
129	08/02/88	TUNGS-CARB	THE SIDE OF THE COUPON FACING THE ELECTRODE IS CORRODED AND PITTED IN AREAS WHERE IT WAS IN THE AIRSTREAM AND SMOOTH IN THE OTHER AREAS. DISCOLORED NAVY BLUE, GRAY AND ORANGE WHERE HUNG ON FRONT. BACK DISCOLORED BLUE, TURQUOISE AND WITH GRAY STRIPES. SURFACE COVERED WITH A FILM, UNDERNEATH ARE POSSIBLE PITS. NO PIT ANALYSIS IS POSSIBLE THROUGH FILM HOWEVER.
130	08/02/88	TUNGS-CARB	STEEL GRAY FILM OVER SURFACE WITH AREA OF BLACK IN FRONT UPPER RIGHT CORNER. IN GENERAL, SCATTERED OXIDATION OVER SURFACE. NO PITTING.
172	07/07/88	WAX	
159	07/12/88	WAX	
164	07/13/88	WAX	
** CN			CN IMMERSION
109	06/23/88	8740	SURFACE LOOKS LIKE ORIGINAL STATE OF COUPON. NO PITS.
94	06/24/88	8740	SURFACE LOOKS LIKE ORIGINAL STATE OF COUPON. NO PITS.
111	06/27/88	8740	SURFACE LOOKS LIKE ORIGINAL STATE OF COUPON. NO PITS.
110	06/29/88	8740	SURFACE LOOKS LIKE ORIGINAL STATE OF COUPON. NO PITS.
106	07/01/88	9310	SURFACE LOOKS LIKE ORIGINAL STATE OF COUPON. NO PITS.
108	07/05/88	9310	CORRODED AND COLORED ORANGE & BLACK WHERE HUNG. GENERAL RUST SPOTS SCATTERED OVER ALL BUT MORE CONCENTRATED TOWARD BOTTOM. NO PITS.
107	07/06/88	9310	SURFACE LOOKS LIKE ORIGINAL STATE OF COUPON. NO PITS.
103	07/01/88	A286	SURFACE LOOKS LIKE ORIGINAL STATE OF COUPON. NO PITS.
105	07/05/88	A286	SURFACE LOOKS LIKE ORIGINAL STATE OF COUPON. NO PITS.
104	07/06/88	A286	SLIGHT BROWN DISCOLORATION UPPER RIGHT FRONT CORNER. NO PITS. RESTORED SURFACE LOOKS LIKE ORIGINAL STATE OF COUPON.
100	07/05/88	BRONZE, FU	DIAMETER AFTER TEST .064. NO PITS. UNIFORM OXIDATION OVER SURFACE.
99	07/06/88	BRONZE, FU	UNIFORM CORROSION. NO PITS.
101	07/01/88	C4340	SURFACE LOOKS LIKE ORIGINAL STATE OF COUPON. NO PITS.
102	07/05/88	C4340	BACK OF COUPON IS DULL AND A STEEL GRAY EXCEPT WHERE IT WAS HUNG. GENERAL RUST SPOTS SCATTERED OVER SURFACE. RUST IS HEAVIER TOWARD BOTTOM. NO PITS.
115	06/23/88	CADMIUM	ENDS OF COUPON ARE WORN DOWN TO TAPERED EDGES. DISCOLORED BLUE-GRAY WITH AREAS OF LIGHTER GRAY SCATTERED OVER ALL. SURFACE DULL. EDGES DISCOLORED BROWN. TWO LAYERS OF UNIFORM CORROSION. FIRST LAYER .0001 INCHES

			DEEP. SECOND LAYER .0003 INCHES DEEP. NO REAL PITS. WHITE FILM DOWN CENTER, FRONT.
92	06/24/88	CADMIUM	BLACK AND DARK GRAY GRANULAR SURFACE. ENDS ARE THINNER THAN MIDDLE. SCATTERED RUST SPOTS ALL OVER. NO PITS.
117	06/27/88	CADMIUM	COUPON IS DULL GRAY AND UNIFORMLY STRIPPED. THE BOTTOM OF THE COUPON HAS MORE METAL REMOVED THAN THE TOP. LIGHT BROWN FILM SCATTERED OVER SURFACE. LIGHT ETCHING OVER SURFACE. UNIFORM CORROSION HAS NO MEASURABLE DEPTH. NO PITS.
116	06/29/88	CADMIUM	THE COUPON HAS A DULL GREY OXIDE COATING WITH NO OBSERVED PITTING. THE TOP PORTION OF THE COUPON ABOVE THE HOLE HAS BEEN UNIFORMLY CORRODED AWAY.
179	07/01/88	CDA 101	SURFACE IS DULL. ENDS ARE DISCOLORED DARK ORANGE. HOLE IS CORRODED. SEVERELY PITTED FRONT AND BACK WITH TO MANY PITS TO COUNT. DEPTH RANGE .0003 INCHES TO .00067 INCHES, AVERAGE DEPTH .0004 INCHES, PITS RUN TOGETHER, FORMING TROUGHS. AVERAGE WIDTH OF TROUGHS IS .002 INCHES.
177	07/05/88	CDA 101	TOP EDGE AND INSIDE HOLE ARE CORRODED. TOO MANY PITS TO COUNT. DEPTH RANGE .0001 INCHES TO .00034 INCHES, AVERAGE DEPTH .00023 INCHES, WIDTH RANGE .001 INCHES TO .024 INCHES, AVERAGE WIDTH .002 INCHES, MANY PITS RUN TOGETHER. AREAS WHICH ARE PITTED ARE ALSO DISCOLORED GOLD. THE DEEPER THE PIT, THE DARKER THE GOLD COLORATION.
178	07/06/88	CDA 101	BROWN DISCOLORATION SCATTERED DOWN RIGHT EDGE AND UPPER LEFT FRONT CORNER. HOLE IS CORRODED. PITTED FRONT AND BACK WITH TOO MANY PITS TO COUNT. DEPTH RANGE .0002 INCHES TO .00046 INCHES, AVERAGE DEPTH .00033 INCHES, WIDTH RANGE .001 INCHES TO .024 INCHES, AVERAGE WIDTH .004 INCHES. BOTTOM OF PITS ARE GOLD COLORED. MOST OF THE PITS WITH A DEPTH OF .0002 INCHES ARE RED AT THE BOTTOM. (POSSIBLY WHERE PURE COPPER IS UNSURFACED.)
112	06/23/88	INDIUM	TRANSPARENT FILM COVERS SURFACE AND REFLECTS VISIBLE LIGHT. LIGHT ETCHING COVERS SURFACE. GENERAL RUST SPOTS SCATTERED OVER ALL SURFACE. APPROXIMATELY FIVE PITS. WIDTH RANGE .008 INCHES TO 0.016 INCHES, AVERAGE WIDTH 0.003 INCHES, DEPTH RANGE .0004 INCHES TO .0007 INCHES, AVERAGE DEPTH .0005 INCHES, PITS ARE ROUND.
93	06/24/88	INDIUM	TRANSPARENT FILM WHICH REFLECTS VISIBLE LIGHT COVERS COUPON. LIGHT ETCHING OVER SURFACE. SOME BLACK OXIDATION EXISTS IN SCATTERED PATCHES. NO PITS.
114	06/27/88	INDIUM	TRANSPARENT FILM COVERS SURFACE AND REFLECTS VISIBLE LIGHT. UNIFORM CORROSION APPARENT UNDERNEATH FILM. SCATTERED BLACK OXIDATION

			OVER ALL. NO PITS.
113	06/29/88	INDIUM	THE COUPON HAS A VERY LIGHT GREENISH OXIDE COATING THAT IS UNIFORM WITH NO PITTING.
175	07/05/88	LEAD	DISCOLORED WITH A DULL GOLD TINT OVER ALL. EDGES DISCOLORED DARK GRAY. UNIFORMLY CORRODED SURFACE WITHOUT MUCH DEPTH. NO PITS.
176	07/06/88	LEAD	GOLD DISCOLORATION SCATTERED OVER SURFACE. SURFACE UNIFORMLY CORRODED BUT HAS NO DEPTH. LIGHT ETCHING OVER SURFACE. ENDS DISCOLORED. APPROXIMATELY TEN PITS. DEPTH RANGE .0001 INCHES TO .00012 INCHES, AVERAGE DEPTH .0001 INCHES, WIDTH RANGE .002 INCHES TO .006 INCHES, AVERAGE WIDTH .004 INCHES.
182	06/23/88	NI200	SURFACE SHINY. IN GENERAL LIGHT OXIDATION SCATTERED OVER ALL, BLACK AND ORANGE IN COLOR. ONE PIT, DEPTH .00016 INCHES, WIDTH .006 INCHES BY .008 INCHES, LEVELS OF UNIFORM CORROSION APPARENT. FIRST LEVEL .0001 INCHES BELOW ORIGINAL SURFACE. SECOND LEVEL .0002 INCHES. THIRD LEVEL .00025 INCHES. LEVELS ALTERNATE OVER SURFACE IN AREAS OF APPROXIMATELY0X. .024 INCHES BY .028 INCHES. AT EACH LEVEL THE GRAIN OF THE METAL RUNS A DIFFERENT DIRECTION.
91	06/24/88	NI200	COPPER DISCOLORATION IN SCATTERED PATCHES, LIGHT ETCHING OVER SURFACE, NO PITS.
181	06/27/88	NI200	SURFACE DULL. LIGHT ETCHING COVERS SURFACE. IN GENERAL LIGHT OXIDATION SCATTERED OVER SURFACE. NO PITS.
180	06/29/88	NI200	THE COUPON IS SHINY WITH NO OBSERVED PITTING. THE FINISH IS VERY UNIFORM, A GOOD FINISH. THERE IS VERY SLIGHT PITTING IN THE TOP INNER PORTION OF THE COUPON HOLE.
376	10/07/88	NI200	
377	10/07/88	NI200	
378	10/07/88	NI200	
183	06/23/88	SILVER	UNIFORM LEVELS OF CORROSION APPARENT OVER ENTIRE COUPON INCLUDING EDGES. FIRST LEVEL .00026 INCHES. BELOW ORIGINAL SURFACE. SECOND LEVEL .0005 INCHES. LEVELS ALTERNATE OVER SURFACE. NO PITS. RUST IN CENTER OF FRONT BUT NO DEPTH. SPOTS OF BLUE DISCOLORATION OVER ALL. IN CENTER FRONT ARE FIBERS ON SURFACE.
147	06/24/88	SILVER	HEAVILY PITTED WITH TOO MANY PITS TO COUNT. DEPTH RANGE .00026 INCHES TO.0021 INCHES, AVERAGE DEPTH .0006 INCHES, PITS WERE LARGE AND RAN TOGETHER. SURFACE HAS A COPPER TINT TO IT.
173	06/27/88	SILVER	SEVERELY PITTED WITH TOO MANY PITS TO COUNT. DEPTH RANGE .0003 INCHES TO.0023 INCHES, AVERAGE DEPTH .0005 INCHES, WIDTH RANGE .002 INCHES TO .024 INCHES, AVERAGE WIDTH .010 INCHES, PITS ARE LARGE AND MANY RUN TOGETHER. IN GENERAL LIGHT OXIDATION SCATTERED OVER

			SURFACE. BACK AND BOTTOM DISCOLORED BLACK.
174	06/29/88	SILVER	THE COUPON HAS BEEN CORRODED OVER ITS ENTIRE SURFACE. THE PITS ARE DEEP. THE HEAVIEST PITTING OCCURS AROUND 0.4 INCHES FROM THE EDGE TOWARD THE CENTER OF THE COUPON.
131	08/02/88	TUNGS-CARB	DISCOLORED STEEL GRAY. NO PITS. SCATTERED RUST SPOTS BUT NO DEPTH.
132	08/02/88	TUNGS-CARB	DISCOLORED STEEL GRAY. WHERE HUNG IS BLACK. NO PITS. SURFACE APPEARS GRANULAR
96	06/22/88	WAX	NA
95	06/24/88	WAX	NA
98	06/27/88	WAX	NA
97	06/29/88	WAX	NA
**	ELECTROCHEMICALS		ELECTROSTRIP S.A.
22	06/15/88	8740	ORANGE DISCOLORATION IN AREA AROUND HOLE AND WHERE HUNG. TWO PITS ABOVE HOLE ON FRONT AND IN CENTER. WIDTH 0.0005 INCHES, DEPTH 0.0003 INCHES, GENERAL OXIDATION OVER FRONT. BEIGE DISCOLORATION AROUND HOLE AND BOTTOM, FRONT. SEMICIRCULAR STREAK OF BLUE AND PURPLE COLOR ACROSS CENTER FRONT. WIDTH OF STREAKS 0.0004 INCHES.
19	06/15/88	9310	COUPON CORRODED WHERE HUNG, LIGHT SCATTERED RUST OVER SURFACE, FRONT HAS GRAY OXIDE COATING OVER IT, NO PITS, HEAVY RUST OVER 2/3 OF BACK, OXIDATION OBSCURES ROLLING GRAIN.
21	06/15/88	A286	HOLE OXIDIZED AS WELL AS AREA WHERE HUNG. BACK LOOKS LIKE ORIGINAL. GENERAL OXIDATION SCATTERED OVER FRONT BUT HEAVIEST IN MIDDLE. ALSO HEAVY OXIDATION TOWARD BOTTOM FRONT. 54 PITS, LOCATED IN UPPER THIRD OF FRONT. WIDTH RANGE IS 0.0002 TO 0.0010 INCHES, AVERAGE WIDTH 0.0006 INCHES, DEPTH RANGE 0.0002 INCHES TO 0.0003 INCHES, PITS ARE ROUND.
27	06/14/88	C4340	AREA AROUND HOLE WHERE COUPON WAS HUNG IS BLACK AND ORANGE. SCATTERED SPOTS OF GRAY AND ORANGE OXIDATION ARE ON FRONT AND BACK. ROLLING GRAIN ARE TO DIFFICULT TO SEE THROUGH "RUST" ON FRONT AND BACK. BOTTOM MORE HEAVILY OXIDIZED. NO PITS
29	06/14/88	CADMIUM	COUPON IS THIN. LEFT UPPER CORNER AND AREA ABOVE HOLE CORRODED AWAY. MORE CORROSION ON BACK. DARK GRAY AND ORANGE DISCOLORATION. SURFACE SEVERELY PITTED. UNIFORM LEVELS OF CORROSION FORMED, FIRST LEVEL .00043 INCHES BELOW ORIGINAL SURFACE, SECOND LAYER .00053 INCHES. LAYERS ALTERNATE OVER SURFACE.
18	06/15/88	CDA 101	HOLE CORRODED. EDGE ROUGH. TOP TAPERED. RIGHT TOP CORNER IS BLACK. SURFACE SEVERELY CORRODED. FIRST LAYER OF CORROSION IS GREEN WITH DEPTH OF 0.00025 INCHES. THE SECOND LAYER OF CORROSION IS GRAY WITH A DEPTH OF 0.0005 INCHES. THE LOWEST LAYER OF CORROSION IS ORANGE WITH A DEPTH OF 0.0102 INCHES. GRANULAR SURFACE. NO DISTINCTIVE PITS, JUST

			GENERAL CORROSION. LAYERS OF CORROSION ALTERNATE OVER SURFACE.
23	06/15/88	CHROMIUM	TOP EDGE IS TAPERED. HOLE DISCOLORED. FRONT SURFACE COVERED WITH RUST. AN AREA 0.4 INCHES BY 0.6 INCHES. CENTER OF FRONT IS NOT COATED WITH RUST. UNDER RUST, SURFACE IS YELLOW AND GREEN, ROLLING GRAIN IS VISIBLE. BACK IS ROUGH LIKE A FINE SAND PAPER. ALSO BACK IS RIPPLED 0.4 INCHES FROM LEFT EDGE AND 0.8 INCHES UP FROM BOTTOM. NO PITS
26	06/14/88	INDIUM	COUPON IS SOFT AND HEAVILY CORRODED. TOO MANY PITS TO COUNT. ABOUT 100 PITS IN FIRST LENS VIEW ALONE. AVERAGE DEPTH 0.0003 INCHES. GRAIN NOT VISIBLE. FRONT IS MUCH MORE PITTED THAN BACK.
28	06/14/88	LEAD	BOTTOM AND LEFT EDGES CORRODED AWAY. BLUE-GRAY FILM OVER SURFACE WITH BEIGE STREAKS. SCATTERED RUST SPOTS OVER ALL. UNIFORM LAYERS OF CORROSION, FIRST LAYER .00022 INCHES BELOW ORIGINAL SURFACE, SECOND LAYER .00036 INCHES.
25	06/14/88	NI200	BACK SURFACE OF COUPON IS DULL. LIGHT ETCHING OVER SURFACE FRONT AND BACK. DARK BROWN OXIDATION FOLLOWING THE GRAIN IS VISIBLE UNDER MICROSCOPE. RUST SPOTS SCATTERED OVER FRONT. ONE PIT. WIDTH 0.0008 INCHES ROUND. DEPTH 0.002 INCHES.
20	06/14/88	SILVER	TOP EDGE OF COUPON IS TAPERED. OTHER THREE EDGES ARE ROUGH AND FRONT SURFACE IS ROUGH ACROSS BOTTOM AND UP THE LEFT SIDE. BACK APPEARS TO HAVE A SMOOTH, THICK GRAY FILM OVER IT. SEVERE CORROSION HAS ATTACKED FRONT SURFACE IN LINES WHICH FOLLOW THE ROLLING GRAIN. DEPTH RANGE 0.0002 INCHES. GRANULAR WHERE CORRODED. EDGES ARE MORE CORRODED THAN CENTER. AVERAGE DEPTH 0.00045 INCHES.
24	06/15/88	TIN	HOLE IS CORRODED. EDGES ARE ROUGH. FRONT, RIGHT SIDE HAS A YELLOW POWDER ON IT WHICH COMES OFF ON CONTACT. BACK ALSO HAS YELLOW POWDER ACROSS TOP, BOTTOM AND DOWN RIGHT SIDE. ENTIRE SURFACE ETCHED WITH A DEPTH OF 0.0003 INCHES. SURFACE LOOKS LIKE ORIGINAL SURFACE.
** ELECTROCHEMICALS			NICKEL-SOL
311	09/21/88	17-4 PH	NO PITS
308	09/21/88	309 SS	
307	09/21/88	316 SS	NO PITS.
312	09/21/88	410 SS	COUPON REALLY SHINY. NO PITS.
309	09/21/88	A236	SCATTERED AREAS OF LOCALIZED ATTACK BUT NO DEPTH. NO PITS.
310	09/21/88	AL 1100	SHINY SURFACE. NO GRAINS VISIBLE WITH OR WITHOUT MICROSCOPE. GLOSSY. NO PITS.
302	09/21/88	BRONZE, FU	
306	09/21/88	C4340	SURFACE IS GRAY. NO PITS. SURFACE GRANULAR

			UNDER MICROSCOPE. CANNOT SEE ROLLING LINES.
305	09/21/88	CADMIUM	
304	09/21/88	CDA 101	TOP PORTION OF COUPON DISSOLVED, CAN NO LONGER SEE GRAIN LINE. POWER PORTION HAS DEEP GRAIN LINES. SURFACE GRANULAR BUT BARELY VISIBLE UNDER THE MICROSCOPE.
303	09/21/88	NI200	SEVERE GENERAL CORROSION. NO WAY TO LOOK FOR PITS. SURFACE IS SANDY OR GRANULAR.
301	09/21/88	TUNGS-CARB	BROWN BLUE COLOR ON BOTH SURFACES. ENTIRE SURFACE ETCHED. NO PITS.
**	FREDRICK GUMM CHEM.		CLEPO 204 (IMMERSION)
189	08/09/88	17-4 PH	FIVE PITS. DEPTH RANGE .00012 INCHES TO .0002 INCHES, AVERAGE DEPTH .00015 INCHES, WIDTH RANGE .002 INCHES TO .004 INCHES, AVERAGE WIDTH .002 INCHES, THE REST OF THE SURFACE LOOKS LIKE ORIGINAL STATE OF COUPON.
188	08/09/88	8740	APPROXIMATELY 77 PITS AROUND HOLE. DEPTH RANGE .0001 INCHES TO .00014 INCHES, AVERAGE DEPTH .00014 INCHES, WIDTH RANGE .001 INCHES TO .004 INCHES, AVERAGE WIDTH .002 INCHES. LIGHT OXIDATION SCATTERED OVER SURFACE. MAY BE THE BEGINNINGS OF PITS BUT NO DEPTH.
187	08/09/88	A286	LOOKS LIKE ORIGINAL STATE OF COUPON. NO PITS.
184	08/09/88	BRONZE, FU	SURFACE DISCOLORED YELLOW AND BLACK. UNIFORM CORROSION OF SURFACE. CORROSION FOLLOWS GRAIN AND HAS A DEPTH OF .0001 INCHES. NO PITS.
186	08/09/88	C4340	LOOKS LIKE ORIGINAL STATE OF COUPON. NO PITS.
121	08/05/88	CADMIUM	COUPON THINNER AND ENDS WORN MORE THIN THAN MIDDLE. DISCOLORED DARK GRAY ALL OVER. UNIFORM CORROSION OVER SURFACE WITHOUT MUCH DEPTH AT ALL. NO PITS.
185	08/09/88	CDA 101	UPPER TWO-THIRDS OF FRONT AND BACK IS DISCOLORED BROWN, YELLOW AND GREEN. BROWN COLOR DUE TO OXIDATION, BUT NO DEPTH APPARENT. NO PITS.
122	08/05/88	INDIUM	SEVERE CORROSION AT A UNIFORM DEPTH OF .0002 INCHES. NO PITS. CORROSION TAKES THE FORM OF TROUGHS. ETCHING COVERS TOP SURFACE WHICH IS NOT CORRODED.
123	08/05/88	NI200	TWO APPARENT LEVELS OF CORROSION. FIRST LEVEL .0002 INCHES BELOW ORIGINAL SURFACE. SECOND LEVEL .0003 INCHES. LEVELS ALTERNATE OVER SURFACE. SCATTERED OXIDATION OVER COUPON. NO REAL PITS.
124	08/05/88	SILVER	SURFACE LOOKS LIKE ORIGINAL STATE. NO PITS.
126	08/05/88	TIN	UNIFORMLY PITTED OVER ENTIRE SURFACE. TOO MANY PITS TO COUNT. DEPTH OF .0001 INCHES, WIDTH RANGE .03 INCHES TO .09 INCHES, AVERAGE WIDTH .06 INCHES. SCATTERED OXIDATION OVER SURFACE.
125	08/05/88	TUNGS-CARB	GRAY FILM COVERS SURFACE AND PIT ANALYSIS IS NOT POSSIBLE THROUGH FILM. SOME BLACK OXIDATION ON FRONT.

** FREDRICK GUMM CHEM.			CLEPO ELECTROSTRIP B/C
149	06/21/88	17-4 PH	THE SURFACE FACING THE ANODE SEEMS TO HAVE A DULLER FINISH THAN THE SIDE THAT WAS FACING AWAY FROM THE ANODE. EDGES DISCOLORED DARK GRAY, BACK UPPER RIGHT CORNER IS BLUE AND GRAY. FRONT IS CORRODED WITH CLUMPS OF PITS. EACH CLUMP CONTAINS APPROXIMATELY 25 PITS. THE OVERALL NUMBER OF PITS IS TOO HIGH TO COUNT. DEPTHS RANGE .0001 INCHES TO .00015 INCHES, AVERAGE DEPTH .0001 INCHES, WIDTH RANGE .001 INCHES TO .008 INCHES, AVERAGE WIDTH .002 INCHES. PITS ARE ROUND
148	06/21/88	8740	SURFACE DISCOLORED DARK GRAY AND ORANGE. UNIFORM CORROSION AT A DEPTH OF .0003 INCHES COVERS COUPON. CORROSION IS SCATTERED AND FORMS PLATEAUS IN THE METAL. CORRODED AREAS ARE BLACK.
151	06/21/88	9310	GENERAL, LIGHT OXIDATION OVER SURFACE BUT NO DEPTH. OXIDATION HEAVIER AT BOTTOM OF COUPON AND THIS AREA APPEARS BLACK. NO PITS.
153	06/21/88	A286	APPROXIMATELY FIVE AREAS OF OXIDATION, .006 INCHES BY .008 INCHES ON COUPON. AREAS ARE ORANGE RIMMED WITH BLUE. NO PITS. SURFACE OTHERWISE LOOKS LIKE ORIGINAL STATE.
152	06/21/88	C4340	BACK AND EDGES DISCOLORED DARK GRAY. AREA WHERE HUNG IS CLEAN. LIGHT OXIDATION OVER SURFACE, ORANGE AND BLACK OXIDATION HEAVIER AT TOP AND BOTTOM OF COUPON. NO PITS.
30	06/17/88	CADMIUM	FRONT AND BACK DISCOLORED DARK GRAY. LESS DISCOLORATION WHERE HUNG. SEVERELY CORRODED, MOSTLY WITH TRENCHES. TRENCH DEPTH IS 0.00021 INCHES. SURFACE OF CORRODED AREA IS RED BROWN, AND GREEN. AREA WHERE TRENCHES DO NOT OCCUR, PITS DO OCCUR. THERE ARE TOO MANY PITS TO COUNT. WIDTH IS 0.0006 INCHES, DEPTH RANGE IS 0.00005 INCHES TO 0.00025 INCHES, AVERAGE DEPTH IS 0.0001 INCHES. GRAIN NOT VISIBLE. PITS ARE ROUND AND OBLONG.
44	06/17/88	CDA 101	AREA WHERE HUNG IS DISCOLORED BROWN. DISCOLORED BEIGE DOWN LEFT BACK AND ACROSS BOTTOM. RIGHT LOWER BACK DISCOLORED PURPLE WITH RADIATING BEIGE LINES. SCATTERED SPOTS OF BLUE AND PURPLE ALL OVER BUT WITH NO DEPTH. SURFACE IS GRANULAR. TWO LAYERS OF FILM COVER FRONT. ORANGE FILM IS 0.0002 INCHES ABOVE SURFACE OF METAL. BLUE FILM IS 0.0001 INCHES ABOVE SURFACE. GRAIN NOT VISIBLE THROUGH FILM. NO PITS
31	06/17/88	CHROMIUM	FRONT SURFACE IS PITTED AND THUS ROUGH LIKE FINE SAND PAPER. THERE ARE TOO MANY PITS TO COUNT. MOST PITS LOCATED ON UPPER HALF OF FRONT. WIDTH RANGE IS 0.00008 TO 0.001 INCHES, AVERAGE WIDTH IS 0.0005 INCHES, DEPTH RANGE IS 0.0002 TO 0.0005 INCHES, AVERAGE DEPTH IS 0.00035 INCHES. LOWER HALF OF FRONT

			IS ORANGE. GRAIN IS VISIBLE WHERE NOT PITTED.
34	06/17/88	INDIUM	SOFT AND SHINY SURFACE. MIDDLE OF BACK DISCOLORED DARK GRAY. (DISCOLORATION OUTLINED IN BACK) LIGHT ETCHING OVER SURFACE LOOKS LIKE CHICKEN WIRE. FRONT IS COVERED WITH PITS AND THERE ARE TOO MANY TO COUNT. WIDTH RANGE IS 1 TO 7 INCREMENTS. AVERAGE WIDTH IS 4 INCREMENTS. DEPTH RANGE IS 0.00015 INCHES TO 0.0005 INCHES, AVERAGE DEPTH IS 0.00024 INCHES. GRAIN IS NOT VISIBLE. CRACKS OF SAME DEPTH CONNECT PITS TO ONE ANOTHER
32	06/17/88	LEAD	MIDDLE OF BACK IS DARK GRAY OUTLINED WITH BEIGE. SEVERE ETCHING ALL OVER FRONT, NO PITS. DEPTH RANGE 0.00018 INCHES TO 0.0005 INCHES, AVERAGE DEPTH IS 0.0003 INCHES, GRAIN NOT VISIBLE. SURFACE IS DISCOLORED BROWN WITH SCATTERED SPOTS OF BLUE AND PURPLE. SURFACE IS GRANULAR
33	06/17/88	NI200	SURFACE DISCOLORATION WHERE HUNG. FRONT IS DULL. SCRATCHES DOWN FRONT LEFT SIDE WHICH ARE DISCOLORED BEIGE. DEPTH OF 0.00015 INCHES. ETCHING OVER SURFACE WHICH LOOKS LIKE CHICKEN WIRE. APPROXIMATELY 170 PITS ON FRONT. WIDTH RANGE IS 1 TO 3 INCREMENTS. AVERAGE WIDTH IS 2 INCREMENTS. DEPTH RANGE IS 0.0001 TO 0.0004 INCHES, AVERAGE DEPTH IS 0.00025 INCHES. SURFACE DISCOLORED BROWN ALONG GRAIN.
150	06/21/88	WAX	
** HNO3			HNO3
81	05/11/88	309 SS	COUPON SURFACE LOOKS LIKE NEW. NO PITS A LOT OF ROLLING DEFECTS BUT NO APPARENT ATTACK AT THESE DEFECTS.
83	05/02/88	410 SS	NO PITS, SLIGHT ETCHING SCATTERED OVER SURFACE A LOT OF DEFECTS IN ORIGINAL SURFACE
82	05/04/88	9310	OPAQUE SMOKY GRAY FILM OVER BOTH SURFACES. UPPER AND OUTER EDGE OF FRONT IS LIGHTER. SCATTERED RUST OVER BOTH SURFACES. ENTIRE SURFACE ETCHED CAN STILL SEE ROLLING GRAIN. RUST SPOTS LOOKS LIKE THEY MAY BE THE BEGINNING OF PITS (APPROXIMATELY 20 ON THE FRONT SURFACE) BUT NO DEPTH YET.
120	05/11/88	A286	SCATTERED RUST 1/2 INCH UP FROM BOTTOM FRONT AND BACK. NO PITS.
79	05/04/88	C276	SEVEN PITS. MAXIMUM DEPTH .0010 INCHES, MINIMUM DEPTH .0004 INCHES, AVERAGE DEPTH .0006 INCHES, WIDTH .008 INCHES, SOME SLIGHT ETCHING.
80	05/11/88	C4340	ORANGE GRAY COLORATIONS AROUND OUTER EDGE OF COUPON, RUST SCATTERED OVER BACK, NO PITS, SURFACE ETCHED LIGHTLY.
84	05/02/88	HASTELOY X	SURFACE LOOKS LIKE ORIGINAL. NO PITS.
85	05/03/88	INCONEL 62	NO PITS, SURFACE LOOKS LIKE NEW.

**	KIESOW INT'L CORP.		NICKEL STRIPPER ST
35	05/19/88	17-4 PH	BLUE PURPLE COLORATIONS AROUND UPPER FRONT AND BACK SURFACE OF THE COUPON. YELLOW OPAQUE FILM COVERS THE REMAINING SURFACES. LOOKS LIKE CRACKS ON SURFACE (SHORT HORIZONTAL 0.0005 INCHES LONG. CANNOT DETERMINE THE DEPTH, THESE CRACKS ARE OFFSET. THERE ARE NO VERTICAL ONES). NO PITS.
39	05/19/88	316 SS	YELLOW COLORATIONS ON FRONT AND BACK SURFACES AROUND EDGE OF COUPON RANGING FROM 1/16 INCHES INWARD TO 3/4 INCHES AT TOP. SPOTTED YELLOW COLORATIONS COVERING REMAINING SURFACE. NO PITS.
43	05/27/88	8740	AREA ABOVE HOLE WHERE COUPON WAS HUNG IS CORRODED AS IS HOLE. THICK RUST OVER TOP THIRD OF COUPON. ALSO LIGHT RUST DOWN BOTH FRONT EDGES. TRANSPARENT RUST SPOTS OVER MOST OF FRONT SURFACE APPARENT UNDER MICROSCOPE. SURFACE UNDER RUST IS DISCOLORED BLUE, PINK, AND YELLOW.
50	06/02/88	8740	SURFACE COVERED WITH RED YELLOW FILM. DOES NOT LOOK LIKE RUST. SOME CORROSION AROUND THE HOLE ENTIRE SURFACE IS ETCHED. CAN NO LONGER SEE THE ROLLING GRAIN. NO PITS.
47	05/27/88	9310	SLIGHT DISCOLORATION AROUND HOLE WHERE HUNG. SLIGHT RUSTING AROUND NATURAL DEFECTS IN COUPON. NO PITS. SURFACE SIMILAR TO ORIGINAL STATE.
49	06/02/88	9310	SOME LIGHT CORROSION AT THE HOLE SURFACE. ETCHED LIGHTLY IN SOME AREAS OF LIGHT TRANSPARENT RUST. NO PITS.
37	05/19/88	A286	BLUE PURPLE DISCOLORATION AROUND UPPER EDGE OF COUPON. SOME SCRATCHES APPARENT FROM HANDLING. NO PITS.
46	05/27/88	A286	HOLE DISCOLORED AS WELL AS AREA WHERE HUNG. RIGHT, TOP EDGE IS RUSTED SLIGHTLY. NO PITS. SURFACE RESEMBLE ORIGINAL STATE.
52	06/02/88	A286	A LIGHT BLUE ORANGE COLOR ABOVE HOLE WHERE COUPON WAS HUNG. NO PITS. SURFACE LOOKS GOOD.
53	06/07/88	C4340	HOLE HEAVILY CORRODED. AREA WHERE HUNG DISCOLORED YELLOW BLUE AND BLACK. LIGHT ETCHING OVER ENTIRE SURFACE. RIGHT EDGE AND BOTTOM OF FRONT DISCOLORED BROWN. BOTTOM EDGE ON BACK DISCOLORED DARK GRAY. CAN STILL SEE ROLLING GRAIN UNDER ETCHING. SLIGHT RUST SCATTERED OVER FRONT. SEVEN PITS WIDTH RANGE 0.0005 TO 0.0026 INCHES, AVERAGE WIDTH 0.0015 INCHES, DEPTH RANGE .0001 INCHESS TO 0.0003 INCHES, AVERAGE DEPTH 0.0002 INCHES. PITS ROUND.
42	05/27/88	CADMIUM	HOLE IS CORRODED WITH A BLACK STREAK LOCATED ABOVE ITS CENTER. YELLOW SCALE COVERS FRONT BOTTOM EDGE AND BOTTOM TWO THIRDS OF BACK. SCALE COMES OFF ON CONTACT AS A POWDER.

			COUPON DISCOLORED GREEN WHITE AND BROWN WHERE HUNG. NO PITS.
45	06/02/88	CADMIUM	SCALE NEEDS TO BE REMOVED PRIOR TO PIT EXAMINATION. SCALE IS A WHITE POWDER COVERING ENTIRE SURFACE APPROXIMATELY 1/32 INCHES THICK. SCALE FLAKES OFF.
388	06/07/88	INDIUM	
36	05/19/88	LEAD	GRAY FILM COVERS ENTIRE SURFACE. LOOKS RATHER THICK LIKE A DEFECT OR LINE (APPROXIMATELY 3/8 INCHES LONG) IN ABOUT THE CENTER OF FRONT AT BOTTOM. GREEN FILM ALONG THE HOLE. BLACK TO GREEN FILM ALONG TOP OF BACK APPROXIMATELY 1/8 INCHES DOWN. SURFACE LOOKS CRYSTALLINE UNDER THE MICROSCOPE. NO PITS APPARENT. CANNOT SEE THE ROLLING GRAINS THROUGH THE FILM. SOME SCRATCHES ARE APPARENT.
40	05/27/88	LEAD	PLATE IS WARPED AND WILL NOT LAY FLAT. HOLE IS CORRODED WITH GRAY AND ORANGE DISCOLORATION WHERE COUPON WAS HUNG. COUPON UNDERNEATH HOLE IS SCALED WITH FIRST A BROWN SCALE AND THEN AN ORANGE SCALE. THE COUPON HAS TOO MANY PITS TO COUNT. THE FRONT SURFACE HAS BEEN EATEN AWAY TO MANY LEVELS 0.0004 INCHES TO 0.0108 INCHES. LIGHT RUST ON ONE FRONT CORNER WITH YELLOW DISCOLORATION.
41	06/02/88	LEAD	TOO SEVERELY CORRODED FOR PIT EXAMINATION. WOULD BE USEFUL TO PHOTOGRAPH.
38	05/19/88	NI200	SMOKY OPAQUE FILM COVERING BOTH SURFACES, NO PITS, A LOT OF AREAS OF INITIAL ROLLING DEFECTS, BUT NO APPARENT ATTACK.
48	05/27/88	NI200	SLIGHT DISCOLORATION WHERE COUPON WAS HUNG. SLIGHT YELLOW DISCOLORATION OVER BACK AND TOP HALF (FRONT). UNDER MICROSCOPE, YELLOW TINT IS CAUSED BY DENSELY SCATTERED, TRANSPARENT RUST SPOTS. NO PITS.
51	06/02/88	NI200	LOOKS LIKE CRACKS (LIKE CHICKEN WIRE) ON UPPER RIGHT HAND CORNER APPROXIMATELY 1/8 INCHES FROM EDGE TO 1/2 INCHES DOWN EDGE. NO PITS. REMAINING SURFACE LOOKS LIKE NEW.
389	06/07/88	SILVER	
** MACDERMID INC.			METEX NICKEL STRIPPER SCB
202	08/30/88	17-4 PH	WATER SPOT DOWN RIGHT SIDE OF FRONT. UNIFORM LEVEL OF CORROSION ALTERNATES WITH ORIGINAL SURFACE AT A DEPTH OF .00015 INCHES. NO PITS.
210	08/29/88	9310	WATER MARK DOWN LEFT SIDE OF FRONT. SLIGHT, SCATTERED RUST OVER SURFACE WITH NO DEPTH. NO PITS.
209	08/29/88	A236	SLIGHT OXIDATION SCATTERED OVER SURFACE. BEGINNINGS OF PITS SCATTERED ALL OVER BUT NO DEPTH.
207	08/29/88	BRONZE, FU	SMALL BLACK SPOTS OF OXIDATION ALL OVER SURFACE. SPOTS HAVE NO DEPTH BUT MAKE ROD APPEAR DARKER. UNIFORM CORROSION OVER SURFACE.

212	08/29/88	C4340	LIGHT OXIDATION SCATTERED OVER SURFACE MAKING SURFACE BROWN. ALONG BOTTOM EDGE IS STRIP OF CORROSION OF DEPTH .00014 INCHES. NO PITS.
203	08/31/88	CADMIUM	
208	08/29/88	CDA 101	FRONT HAS SCATTERED AREAS OF DARKER ORANGE COLOR. BACK HAS TWO AREAS WHICH WERE CORRODED AND SURFACE HERE APPEARS LIGHTER ORANGE. NATURAL DEFECTS ARE BLACK WITH OXIDATION. NO PITS.
205	08/31/88	INDIUM	DISCOLORED DARK GRAY GREEN AND PINK. DISCOLORED BLACK ALONG UPPER EDGE. UNIFORM CORROSION WITHOUT MUCH DEPTH. NO PITS. LIGHT, SCATTERED OXIDATION OVER SURFACE. LIGHT ETCHING SCATTERED OVER SURFACE.
211	08/29/88	NI200	SLIGHT OXIDATION SCATTERED OVER SURFACE. LIGHT ETCHING SCATTERED OVER SURFACE. APPROXIMATELY 26 PITS. DEPTH RANGE .00005 INCHES TO .0001 INCHES, AVERAGE DEPTH .0001 INCHES, WIDTH RANGE .002 INCHES TO .006 INCHES, AVERAGE WIDTH .004 INCHES, PITS ARE ROUND.
204	08/31/88	TIN	LIGHT GREEN SCALE COVERS COUPON. THE SCALE CONTAINS DEFECTS BUT THERE ARE NO PITS. EDGES ARE PITTED. SCATTERED OXIDATION BENEATH SCALE.
206	08/31/88	TUNGS-CARB	DISCOLORED STEEL GRAY. EDGES PITTED AND THINNER THAN ORIGINALLY. BLACK WHERE HUNG. SCATTERED LIGHT OXIDATION OVER SURFACE.

** MACDERMID INC. — METEX SILVER STRIPPER CB

318	09/26/88	17-4 PH	NO PITS.
316	09/26/88	BRONZE, FU	LOOKS LIKE ORIGINAL, NO PITS.
315	09/26/88	C4340	NO PITS.
317	09/26/88	CDA 101	COUPON HAS BEEN SEVERELY CORRODED PREVIOUSLY AND REPOLISHED, NO PITS.
313	09/26/88	NI200	HAS BEEN REPOLISHED, CRYSTALLINE SURFACES AT EDGES, NO PITS.
314	09/26/88	SILVER	

** METALLINE CHEM CORP. — 6400 (NI)

218	08/27/88	17-4 PH	WATER SPOT ACROSS BOTTOM OF FRONT. LIGHT OXIDATION SCATTERED OVER SURFACE. APPROXIMATELY ELEVEN PITS. DEPTH RANGE .00013 INCHES TO .00014 INCHES, AVERAGE DEPTH .00013 INCHESSSS, WIDTH RANGE .002 INCHES TO .004 INCHES, AVERAGE WIDTH .002 INCHES.
395	11/02/88	8740	
398	11/02/88	9310	
216	08/27/88	A286	LIGHT OXIDATION SCATTERED OVER SURFACE. NO PITS.
215	08/27/88	BRONZE, FU	SURFACE OXIDIZED AND DISCOLORED BROWN. UNIFORM CORROSION OVER SURFACE. NO PITS.
217	08/27/88	C4340	BEGINNINGS OF PITS WITHOUT DEPTH. MAY BE BOTTOMS OF PITS FROM PREVIOUS TESTING.
214	08/26/88	CADMIUM	ENDS ARE THINNER THAN MIDDLE. YELLOW SCALE ON

			SURFACE FOLLOWS GRAIN. TOO MANY PITS TO COUNT. DEPTH RANGE .0001 INCHES TO .00019 INCHES, AVERAGE DEPTH .00013 INCHES, WIDTH RANGE .001 INCHES TO .010 INCHES. LIGHT OXIDATION SCATTERED OVER SURFACE.
397	11/02/88	CADMIUM	
213	08/26/88	NI200	BLACK ALONG TOP AND BOTTOM EDGES OF BOTH SIDES. LIGHT OXIDATION SCATTERED OVER SURFACE. TOO MANY PITS TO COUNT. DEPTH RANGE .0001 INCHES TO .0002 INCHES, AVERAGE DEPTH .00012 INCHES, WIDTH RANGE .004 INCHES TO .006 INCHES, AVERAGE WIDTH .004 INCHES. PITS ARE OBLONG.
396	11/02/88	NI200	
** METALLINE CHEM CORP.			STRIPPER 672
267	09/08/88	17-4 PH	LOOKS LIKE ORIGINAL STATE. NO PITS.
268	09/08/88	410 SS	LOOKS LIKE ORIGINAL STATE. NO PITS.
266	09/08/88	9310	A FEW PITS BUT NO DEPTH.
270	09/08/88	BRONZE, FU	DULL BLACK IN COLOR. NO PITS.
269	09/08/88	C4340	LIGHT RUST SCATTERED OVER SURFACE BUT WITH NO DEPTH. SCATTERED AREAS OF GRAY FILM ON SURFACE OF A THICKNESS OF .0001 INCHES. NO PITS.
275	09/08/88	CADMIUM	ENDS ARE THINNER THAN MIDDLE. DISCOLORED WITH VARIOUS SHADES OF GRAY. BEIGE COATING COVERS SURFACE AT A THICKNESS OF .00005 INCHES. LIGHT RUST WITH NO DEPTH SCATTERED OVER SURFACE. NO PITS.
265	09/08/88	CDA 101	DISCOLORED YELLOW PURPLE BLUE AND BLACK ALL OVER. UPPER LEFT FRONT CORNER RUSTED BUT HAS NO DEPTH. NO PITS.
272	09/08/88	CHROMIUM	LOOKS LIKE ORIGINAL STATE. NO PITS.
271	09/08/88	LEAD	TOP THINNER THAN REST OF COUPON. COVERED WITH OPAQUE ORANGE FILM. NO PITS.
274	09/08/88	NI200	LOOKS LIKE ORIGINAL STATE. NO PITS.
273	09/08/88	TIN	SURFACE DULL GRAY. SEVERELY CORRODED WITH APPARENT LEVELS OF UNIFORM CORROSION. FIRST LEVEL .00051 INCHES BELOW ORIGINAL SURFACE. SECOND LEVEL .00034 INCHES BELOW. THIRD LEVEL .00015 INCHES BELOW. TOP MORE CORRODED THAN BOTTOM. LEVELS ALTERNATE OVER SURFACE. NO PITS
276	09/08/88	TUNGS-CARB	STEEL GRAY IN COLOR WITH BLACK AROUND HOLE. SCATTERED LIGHT OXIDATION OVER SURFACE. BEGINNINGS OF PITS BUT HAVE NO DEPTH. (MAY BE BOTTOMS OF PITS FROM PREVIOUS TESTING.)
** METALLINE CHEM CORP.			ZINC STRIPPER
279	09/12/88	17-4 PH	LOOKS LIKE ORIGINAL STATE. NO PITS.
277	09/12/88	410 SS	WATER MARK ACROSS BOTTOM OF BACK. BEGINNINGS OF PITS WITHOUT DEPTH. (MAY BE BOTTOMS OF PITS FROM PREVIOUS TESTING.)
280	09/12/88	9310	LOOKS LIKE ORIGINAL STATE. NO PITS.
232	09/12/88	BRONZE, FU	LOOKS LIKE ORIGINAL STATE. NO PITS.

278	09/12/88	C4340	BEGINNINGS OF PITS WITHOUT DEPTH. (MAY BE BOTTOMS OF PITS FROM PREVIOUS TESTING.) OTHERWISE LOOKS LIKE ORIGINAL SURFACE.
288	09/13/88	CADMIUM	DULL GOLD TINT TO SURFACE. RED AND GREEN DISCOLORATION OVER SURFACE LIGHT OXIDATION SCATTERED OVER SURFACE. NO PITS.
281	09/12/88	CDA 101	FRONT UPPER LEFT CORNER IS GOLD. REST OF FRONT DISCOLORED BLUE PURPLE PINK GREEN AND DARKER ORANGE. BACK ABOVE HOLE IS GOLD. DOWN BOTH SIDES OF BACK IS BLUE PURPLE PINK AND GREEN. TOO MANY PITS TO COUNT. DEPTH RANGE .00015 INCHES TO .0005 INCHES, AVERAGE DEPTH .0003 INCHES, WIDTH RANGE .006 INCHES TO 010 INCHES, AVERAGE WIDTH .006 INCHES. A LOT OF PITS RUN TOGETHER.
285	09/13/88	CHROMIUM	WATER MARK LEFT FRONT SIDE. LIGHT OXIDATION SCATTERED OVER SURFACE. NO PITS.
286	09/13/88	INCONEL 62	DULL LIGHT GRAY COATING ALL OVER COUPON. APPROXIMATELY 54 PITS. DEPTH RANGE .0001 INCHES TO .00025 INCHES, AVERAGE DEPTH .0002 INCHES, WIDTH RANGE .004 INCHES TO.010 INCHES, AVERAGE WIDTH .006 INCHES.
284	09/13/88	NI200	LOOKS LIKE ORIGINAL STATE. NO PITS.
287	09/13/88	TIN	DULL LIGHT GRAY AND BEIGE DISCOLORATION ALL OVER. APPROXIMATELY FIFTEEN PITS. DEPTH .0001 INCHES, WIDTH .006 INCHES, SOME PITS ARE RED.
283	09/13/88	TUNGS-CARB	EDGES CENTER OF BACK FRONT LEFT SIDE, AND AROUND HOLE ARE DULL GRAY. NO PITS. LIGHT OXIDATION SCATTERED OVER SURFACE.
** OMI INT'L CORP.			OXYSTRIP 6000
361	09/19/88	17-4 PH	SOME LIGHT YELLOW DISCOLORATION, NO PITS.
367	09/20/88	309 SS	
360	09/19/88	410 SS	LOCALIZED DISCOLORATION AT HOLE. NO PITS.
362	09/19/88	9310	DARK AREAS AT HOLE LOWER RIGHT FRONT CORNER AND SMEARED ACROSS LOWER BACK. NO PITS.
359	09/19/88	A286	ORANGE BLACK COLOR 1/4 INCHES AROUND HOLE. RUST ORANGE COLOR (OPAQUE) ACROSS CENTER FRONT OF COUPON. NO PITS. AREAS OF RUST SCATTERED ACROSS COUPON, VISIBLE BY MICROSCOPE.
368	09/20/88	AL 1100	22 PITS IN 1/4 X 1/2 INCH AREA ON LOWER BACK APPROXIMATELY 1/64 INCH DEEP. ENTIRE SURFACE ETCHED. CAN BARELY SEE THE ROLLING LINES.
369	09/20/88	BRONZE, FU	SEVERE GENERAL CORROSION. LITTLE OF THE WIRE IS REMAINING AT THE LOWER EDGE.
358	09/19/88	C4340	OUTER EDGE OF FRONT OF COUPON IS RIFLE BLUE OPAQUE. RUST COLOR IN CENTER AND AT THE HOLE. BACK SURFACE IS YELLOW GRAY. NO PITS.
363	09/19/88	CADMIUM	THERE IS ESSENTIALLY NO COUPON.
364	09/20/88	CHROMIUM	BACK IS CRYSTALLINE. FRONT HAS BLACK BURNED SPOT AT HOLE. SURFACE ETCHED. CAN BARELY SEE THE ROLLING LINES. NO PITS.
365	09/20/88	NI200	SEVERE GENERAL CORROSION ON BOTH SURFACES.

			SURFACE IS GRANULAR. CANNOT EXAMINE FOR PITS.
366	09/20/88	TUNGS-CARB	LIGHT GRAY BLACK FILM ON BOTH SURFACES. NO PITS.
** OMI INT'L CORP.			UDYSTRIP 406
349	09/15/88	17-4 PH	COUPON SILVER BLACK. ROLLING OR LINES ARE DEEP AND UNEVEN. NO PITS.
348	09/15/88	410 SS	SURFACE IS GRAY BLACK. NO PITS. SURFACE IS GRANULAR UNDER MICROSCOPE.
350	09/15/88	9310	COUPON IS GRAY BLACK COLOR. DOESN'T REALLY LOOK LIKE A FILM. CAN SEE THE ROLLING (POLISHING) LINES WITH OUT MICROSCOPE. GENERAL CORROSION COVERING ENTIRE SURFACE IS VISIBLE UNDER THE MICROSCOPE. NO PITS.
352	09/15/88	BRONZE, FU	WIRE HAS OXIDIZED TO BLACK SURFACE. NO PITS. LARGE AREAS OF OXIDATION COVERING SURFACE OF WIRE.
347	09/15/88	C4340	13 PITS 1/32 INCHES DEEP IN CENTER FRONT, 27 PITS ON BACK ~ 1/32 INCHES DEEP. WIDTH OF THE PITS ARE ~1/8 INCHES.
353	09/16/88	CADMIUM	SEVERE GENERAL CORROSION AT THE TOP OF THE COUPON ON BOTH SIDES. LIGHT BLACK FILM ON COUPON. NO PITS. SURFACE, WHERE NONCORRODED, IS CRYSTALLINE.
351	09/15/88	CDA 101	DARK OXIDATION AT TOP OF COUPON. LIGHT OXIDATION OVER REMAINING COUPON. NO PITS.
354	09/16/88	CHROMIUM	NO PITS. MAY BE LIGHT CHANGE OF SURFACE.
355	09/16/88	NI200	GENERAL CORROSION OR DISSOLUTION ON BOTH SURFACES. GRANULAR OR GRAINY LOOKING SURFACE. CANNOT EXAMINE FOR PITTING.
356	09/16/88	SILVER	GENERAL CORROSION COVERING BOTH FRONT AND BACK SURFACE. VERY LITTLE OF THE ORIGINAL SURFACE REMAINING. COUPON IS ORANGE BLACK IN COLOR. "CRATERS" COVERING ENTIRE SURFACE. BACK IS WORSE THAN FRONT, CAN'T REALLY EXAMINE FOR PITS.
357	09/16/88	TUNGS-CARB	SOME DARK DISCOLORATION AROUND EDGE OF COUPON. ALSO A DARK CIRCLE IN UPPER HALF FRONT. DARK SPOTS COVERING COUPON BUT LOOK LIKE THEY ARE FROM A PREVIOUS RUN. DO NOT APPEAR TO BE PITS.
** OMI INT'L CORP.			UDYSTRIP 460
222	08/20/88	17-4 PH	LIGHTLY RUSTED AREA MIDDLE OF BACK BUT HAS NO DEPTH. NO PITS.
219	08/20/88	309 SS	LOOKS LIKE ORIGINAL STATE. NO PITS.
221	08/20/88	8740	LOOKS LIKE ORIGINAL STATE. NO PITS.
220	08/20/88	9310	LOOKS LIKE ORIGINAL STATE. NO PITS.
223	08/20/88	A286	LOOKS LIKE ORIGINAL STATE. NO PITS.
228	08/25/88	BRONZE, FU	DISCOLORED DARKER BROWN THAN ORIGINAL. COVERED WITH LIGHT GRAY OXIDATION COATING. NO PITS.
224	08/20/88	C4340	LOOKS LIKE ORIGINAL STATE. NO PITS.
229	08/25/88	CADMIUM	COUPON VERY THIN. HOLE OPENED UP AT TOP.

			CORNERS ROUNDED. COVERED WITH SMOOTH, TRANSPARENT FILM. DISCOLORED BEIGE. LIGHT ETCHING AND OXIDATION SCATTERED OVER SURFACE. UNIFORM CORROSION WITHOUT MUCH DEPTH. TWO PITS. DEPTH .0003 INCHES, WIDTH .008 INCHES.
227	08/25/88	CDA 101	LIGHT ETCHING AND OXIDATION SCATTERED OVER SURFACE. TOO MANY PITS TO COUNT. DEPTH RANGE .00013 INCHES TO .00015 INCHES, AVERAGE DEPTH .00013 INCHES, WIDTH RANGE .001 INCHES TO .002 INCHES, AVERAGE WIDTH .002 INCHES, PITS ARE OBLONG.
226	08/25/88	NI200	LOOKS LIKE ORIGINAL STATE. NO PITS.
225	08/25/88	TIN	CORNERS ROUNDED. LIGHT OXIDATION SCATTERED OVER SURFACE. UNIFORM CORROSION OVER SURFACE WITHOUT MUCH DEPTH. APPROXIMATELY FIVE PITS. DEPTH IS .00019 INCHES, WIDTH IS .002 INCHES.
230	08/25/88	TUNGS-CARB	LIGHT OXIDATION SCATTERED OVER SURFACE. NO PITS.
** OMI INT'L CORP.			UDYSTRIP 7000
345	09/22/88	17-4 PH	BLUE OUTER EDGE, YELLOW SILVER CENTER. NO PITS.
380	/ /	309 SS	
343	09/22/88	309 SS	WITHOUT MICROSCOPE, SURFACE SHINY "CRYSTALLINE" OR SMEARED. NO PITS.
346	09/22/88	410 SS	NO PITS, ALL SURFACE DEFECTS ARE PRIOR TO TREATMENT.
341	09/22/88	8740	COUPON RIFLE BLUE ON OUTER EDGE ORANGE YELLOW THE REMAINING SURFACE. SURFACE CRYSTALLINE UNDER MICROSCOPE. NO PITS.
342	09/22/88	9310	SOME LOCALIZED CORROSION ON BACK LEFT EDGE AND AROUND THE HOLE. EASILY VISIBLE WITHOUT THE MICROSCOPE . PIT .0009 INCHES DEEP ROUND 0.19 INCHES WIDE, PIT 0.0004 INCHES DEEP ROUND 0.19 INCHES WIDE, 3 PITS 0.0005 INCHES DEEP ROUND .08 INCHES WIDE. SCATTERED LOCALIZE CORROSION, OVER ENTIRE FRONT SURFACE DEPTH IS LESS THAN 0.0001 INCHES.
338	09/22/88	BRONZE, FU	LOWER LEG AND BEND ARE REDDISH COLOR. THERE DOES NOT APPEAR TO BE ANY PITTING.
379	/ /	C4340	
344	09/22/88	C4340	SCATTERED RUST COLOR (OPAQUE) ON LOWER FRONT QUARTER OF COUPON AND LEFT EDGE ~1/4 INCHES, NO PITS, RUST AREAS HAVE NO DEPTH.
336	09/22/88	CADMIUM	THERE IS NONE OF THE ORIGINAL SURFACE REMAINING, COUPON HAS BEEN ESSENTIALLY CONSUMED BY CORROSION. THERE IS NO SURFACE TO EXAMINE FOR PITTING.
337	09/22/88	CDA 101	LOWER EDGE SHOWS BLACK OXIDATION. SURFACE HEATED OR SMEARED IN REPOLISHING, CRYSTALLINE. NO PITTING.
340	09/22/88	NI200	CRYSTALLINE SHINY SURFACE. NO PITS.
339	09/22/88	TUNGS-CARB	THIN SILVER GRAY CRYSTALLINE OR POWDERY FILM COVERING BOTH SURFACES, CANNOT SEE ORIGINAL SURFACE THROUGH THE FILM TO EXAMINE FOR PITS.

** OMI INT'L CORP.			UDYSTRIP XPS-306
233	08/20/88	17-4 PH	LOOKS LIKE ORIGINAL STATE. NO PITS.
231	08/20/88	309 SS	LOOKS LIKE ORIGINAL STATE. NO PITS.
232	08/20/88	8740	ETCHING COVERS SURFACE AND FOLLOWS THE GRAIN. DEPTH .0002 INCHES. THESE TROUGHS HAVE BLACK OXIDATION INSIDE OF THEM. NO PITS.
235	08/20/88	9310	LOOKS LIKE ORIGINAL STATE. NO PITS.
234	08/20/88	A286	LOOKS LIKE ORIGINAL STATE. NO PITS.
240	08/23/88	BRONZE, FU	ROD WAS BENT SO THAT SOME AREAS ARE EXPOSED MORE THAN OTHERS. THESE EXPOSED AREAS ARE PITTED. DEPTH RANGE .0001 INCHES TO .0003 INCHES, AVERAGE DEPTH .0001 INCHES, WIDTH RANGE .004 INCHES TO .006 INCHES, AVERAGE WIDTH .004 INCHES. AREAS WHICH WERE NOT AS EXPOSED LOOK LIKE ORIGINAL STATE AND HAVE NO PITS.
236	08/20/88	C4340	APPROXIMATELY TWELVE PITS. PITS ARE OBLONG. DEPTH IS .0003 INCHES, WIDTH RANGE .002 INCHES TO .006 INCHES, AVERAGE WIDTH .004 INCHES.
239	08/23/88	CADMIUM	SURFACE COVERED WITH PATCHES OF GREEN FILM. ENDS ARE THINNER THAN MIDDLE. SCATTERED RUST AND OXIDATION UNDERNEATH FILM. TOO MANY PITS TO COUNT. DEPTH RANGE .00012 INCHES TO .0002 INCHES, AVERAGE DEPTH .00014 INCHES, WIDTH RANGE .002 INCHES TO .004 INCHES, AVERAGE WIDTH .002 INCHES.
242	08/23/88	CDA 101	EDGES BLACK. TOP EDGE PITTED. TOO MANY PITS TO COUNT. DEPTH RANGE .0001 INCHES TO .0007 INCHES, AVERAGE DEPTH .0005 INCHES, WIDTH RANGE .001 INCHES TO .004 INCHES, AVERAGE WIDTH .003 INCHES, MANY PITS ARE RED AT THEIR BOTTOM, INDICATING PURE COPPER.
238	08/23/88	NI200	SCATTERED AREAS OF RUST WITHOUT MUCH DEPTH. LIGHT ETCHING SCATTERED OVER ALL. UNIFORM CORROSION AT A DEPTH OF .0001 INCHES, TOO MANY PITS TO COUNT. DEPTH RANGE .00005 INCHES TO .0004 INCHES, AVERAGE DEPTH .00012 INCHES,WIDTH RANGE .002 INCHES TO .006 INCHES, AVERAGE WIDTH .004 INCHES.
241	08/23/88	TIN	HEAVY OXIDATION SCATTERED OVER SURFACE. TOO MANY PITS TO COUNT. DEPTH RANGE .0001 INCHES TO .00018 INCHES, AVERAGE DEPTH .00015 INCHES, WIDTH RANGE .001 INCHES TO .006 INCHES, AVERAGE WIDTH .001 INCHES.
237	08/23/88	TUNGS-CARB	BEGINNINGS OF PITS SCATTERED OVER SURFACE BUT HAVE NO DEPTH YET. LIGHT OXIDATION ALSO SCATTERED OVER SURFACE.
** PATCLIN			DIP N STRIP III
252	08/27/88	17-4 PH	LIGHT OXIDATION SCATTERED OVER SURFACE. TOO MANY PITS TO COUNT. WIDTH RANGE .0004 INCHES TO .0008 INCHES, AVERAGE WIDTH .0005 INCHES. NO MEASURABLE DEPTH.
251	08/27/88	8740	LOOKS LIKE ORIGINAL STATE. NO PITS.

250	08/27/88	9310	LOOKS LIKE ORIGINAL STATE. NO PITS.
249	08/27/88	A286	LIGHT RUST SCATTERED OVER SURFACE BUT HAS NO DEPTH. NO PITS.
245	08/29/88	BRONZE, FU	LIGHT OXIDATION SCATTERED OVER SURFACE. NO PITS.
248	08/27/88	C4340	APPROXIMATELY TWELVE PITS. DEPTH RANGE .0001 INCHES TO .00012 INCHES, AVERAGE DEPTH .0001 INCHES, WIDTH RANGE .002 INCHES TO .004 INCHES, AVERAGE WIDTH .002 INCHES, REST OF SURFACE LOOKS LIKE ORIGINAL.
243	08/29/88	CADMIUM	THINNER THAN ORIGINAL. CORNERS ROUNDED. DARK GRAY FILM .00007 INCHES THICK COVERS SURFACE.
246	08/29/88	CDA 101	SURFACE DISCOLORED BRIGHT RED WITH BLUE AND GREEN. SCATTERED, BROWN OXIDATION OVER SURFACE. APPROXIMATELY 35 PATCHES OF CORROSION WHERE SURFACE IS GRAY. DEPTH .0005 INCHES, WIDTH RANGE .004 INCHES TO .010 INCHES, AVERAGE WIDTH .006 INCHES. NO PITS.
244	08/29/88	NI200	DISCOLORED DARK GRAY IN SCATTERED AREAS. TOO MANY PITS TO COUNT BUT DO NOT HAVE MUCH DEPTH. WIDTH .001 INCHES, ONE LEVEL OF UNIFORM CORROSION APPARENT AT A DEPTH OF .00008 INCHES, OXIDATION MAKES CORRODED AREAS BROWN.
247	08/29/88	TUNGS-CARB	LIGHT GRAY FILM COVERS SURFACE AND GETS THICKER TOWARDS MIDDLE OF COUPON. FILM IS .00002 INCHES THICK IN MIDDLE OF COUPON. NO PITS.

** PATCLIN PATSTRIP NI

296	09/13/88	17-4 PH	FRONT SURFACE HAS LIGHT ETCHING, BACK HAS LIGHT GENERAL CORROSION ON LOWER HALF. AREAS OF LOCALIZED CORROSION OR RUST SCATTERED OVER ENTIRE SURFACE. NO DEPTH. NO PITS.
299	09/13/88	309 SS	DARK COLORATIONS OVER FRONT SURFACE AND LOWER BACK. SURFACE IS ALMOST CRYSTALLINE. NO PITS.
298	09/13/88	410 SS	GENERAL CORROSION COVERING BOTH THE FRONT AND BACK SURFACE. NONE OF THE ORIGINAL SURFACE REMAINING. SURFACE IS CRYSTALLINE UNDER THE MICROSCOPE.
300	09/13/88	BRONZE, FU	NO PITS CORROSION OR OXIDATION OCCURRING ALONG ENTIRE LENGTH OF THE WIRE.
297	09/13/88	C4340	GENERAL CORROSION COVERING BOTH THE FRONT AND BACK SURFACE. NONE OF THE ORIGINAL SURFACE REMAINING. SURFACE IS CRYSTALLINE UNDER THE MICROSCOPE.
293	09/14/88	CADMIUM	VERY THIN. HOLE OPENED UP AT TOP. CORNERS ROUNDED. LIGHT RUST SCATTERED OVER BACK. UNIFORM CORROSION WITHOUT MUCH DEPTH. NO PITS.
295	09/13/88	CDA 101	NO PITS, LIGHT SURFACE OXIDATION.
290	09/14/88	CHROMIUM	SCATTERED BLACK OXIDATION WITHOUT DEPTH OVER SURFACE. NO PITS.

292	09/14/88	NI200	DISCOLORED DARK GRAY. SCATTERED SPOTS OF GOLD TINTING AND RUST OVER SURFACE. THREE LEVELS OF CORROSION ALTERNATE OVER SURFACE. CORROSIONS IN THE FORM OF TROUGHS. LEVELS AT DEPTHS OF .00011 INCHES, .00017 INCHES, .00036 INCHES.
289	09/14/88	SILVER	SCATTERED RUST WITHOUT DEPTH. NO PITS.
294	09/14/88	TIN	DISCOLORED DARK GRAY. MIDDLE OF BACK YELLOW. MIDDLE OF FRONT ORANGE. HOLE OPENED THROUGH AT TOP. VERY THIN. TWO LEVELS OF UNIFORM CORROSION ALTERNATE OVER SURFACE. DEPTHS OF .0004 INCHES AND .0002 INCHES. NO REAL PITS.
291	09/14/88	TUNGS-CARB	RUST SCATTERED OVER FRONT AND ACROSS MIDDLE OF BACK. BLUE AND PURPLE DISCOLORATION SCATTERED OVER SURFACE. LIGHT GRAY FILM COVERS COUPON UP TO WHERE HUNG. NO PITS.
** PATCLIN			PATSTRIP NI-E
256	09/01/88	17-4 PH	TWO THIRDS OF COUPON CORRODED COMPLETELY AWAY. HOLE HAS BEEN ENLARGED BY CORROSION. BACK DISCOLORED DARK BROWN AND RUSTED. FRONT RUSTED OVER UPPER TWO THIRDS. CENTER TOP OF FRONT DISCOLORED YELLOW AND BLACK. SEVERELY CORRODED WITH AREAS OF PITS WHICH HAVE RUN TOGETHER. DEPTH RANGE .0001 INCHES TO .0007 INCHES, AVERAGE DEPTH .00025 INCHES, CORRODED AREAS PINK AND GREEN AT BOTTOM.
255	09/01/88	410 SS	BACK DISCOLORED DULL GRAY. BACK LOWER LEFT CORNER RUSTED. WHERE HUNG SURFACE IS RED BROWN YELLOW AND BLUE. FRONT RED-BROWN. APPROXIMATELY SIX PITS. DEPTH .00005 INCHES, WIDTH .004 INCHES.
258	09/01/88	8740	DISCOLORED BROWN AND BLACK. FRONT HAS THREE AREAS 0.1 INCHES BY 0.1 INCHES WHICH ARE RUSTED BUT HAVE NO DEPTH. LIGHT OXIDATION SCATTERED OVER SURFACE BEGINNINGS OF PITS ALL OVER BUT NO DEPTH YET. OXIDATION IS BLUE AND GREEN UNDER MICROSCOPE.
253	09/01/88	9310	BACK DISCOLORED BROWN WITH GRAY PURPLE AND BLUE. FRONT DISCOLORED BEIGE BLUE AND PURPLE IN AN OBLONG PATTERN. BEGINNINGS OF PITS BUT WITHOUT ANY DEPTH. (MAY BE BOTTOMS OF PITS FROM PREVIOUS TESTING.)
257	09/01/88	A286	CORNERS ROUNDED. RUSTED WHERE HUNG. FRONT DISCOLORED YELLOW AND BLUE IN AN OBLONG PATTERN. LIGHT ETCHING OVER BOTTOM HALF OF COUPON. TOO MANY PITS TO COUNT. DEPTH RANGE .0001 INCHES TO .00028 INCHES, AVERAGE DEPTH .00012 INCHES, WIDTH RANGE .001 INCHES TO .006 INCHES, AVERAGE WIDTH .004 INCHES.
259	09/06/88	BRONZE, FU	ENDS ARE THINNER THAN ORIGINAL. DISCOLORED BROWN. BLACK WHERE HUNG. UNIFORM CORROSION. NO PITS.
254	09/01/88	C4340	BACK DISCOLORED DULL BROWN. FRONT DISCOLORED BROWN AND GRAY. LEFT SIDE OF FRONT COVERED

			WITH A FILM WHICH IS YELLOW RED BLUE GREEN AND PURPLE. SPOTS OF BLUE OXIDATION SCATTERED ALL OVER. TOO MANY PITS TO COUNT. DEPTH RANGE .00005 INCHES TO .0001 INCHES, AVERAGE DEPTH .0001 INCHES, WIDTH RANGE .006 INCHES TO .010 INCHES, AVERAGE WIDTH .008 INCHES.
260	09/06/88	CADMIUM	HALF OF COUPON HAS BEEN CORRODED AWAY. VERY THIN AND BRITTLE. WHITE COATING OVER MOST OF FRONT AND BACK. BACK IS MORE CORRODED THAN FRONT. NO PITS.
262	09/06/88	CDA 101	SPOTS OF GREEN BLACK AND DARK BROWN SCATTERED OVER SURFACE. ONE THIRD OF COUPON CORRODED AWAY. SEVERELY CORRODED WITH ALTERNATING LEVELS OF DEPTH .0001 INCHES, .00015 INCHES, .00024 INCHES, .00037 INCHES, NO PITS.
261	09/06/88	CHROMIUM	LOWER TWO-THIRDS OF FRONT DISCOLORED YELLOW ORANGE BLUE PURPLE GREEN AND RUST BUT WITH NO DEPTH. ABOVE HOLE ARE APPROXIMATELY 52 PITS. NO DEPTH. WIDTH .0005 INCHES.
263	09/06/88	NI200	CORRODED WHERE HUNG. ETCHING TOWARD BOTTOM. TOO MANY PITS TO COUNT. DEPTH RANGE .00005 INCHES TO .0005 INCHES, AVERAGE DEPTH .0002 INCHES, WIDTH RANGE .001 INCHES TO .003 INCHES, AVERAGE WIDTH .001 INCHES.
264	09/06/88	TUNGS-CARB	UNIFORM CORROSION AT A DEPTH OF .00013 INCHES. NO REAL PITS.
** PATCLIN			PATSTRIP NIX-85
332	09/29/88	17-4 PH	NO PITS.
56	05/16/88	309 SS	9 PITS APPROXIMATELY 0.0002 INCHES DEEP AND 0.0002 TO 0.0005 INCHES WIDE. SURFACE ETCHED, AREAS WHERE ETCHING BECOMES SEVERE (TOUGH TO SEE THE ROLLING GRAIN).
8	05/17/88	316 SS	NO PITS, SURFACE ETCHED LIGHTLY.
54	05/16/88	410 SS	SLIGHT ETCHING OF SURFACE LOOKS LIKE 3 SPOTS WHERE PITS MAY BE STARTING BUT NO DEPTH YET.
119	05/16/88	8740	RUSTED AREA ON FRONT 1/2 INCH BY 1/2 INCH. RUST DENSE BUT WITH NO DEPTH. NO PITS.
55	05/16/88	9310	VERY SLIGHT ETCHING ON SURFACE. NO PITS.
330	09/29/88	9310	NO PITS.
7	05/17/88	A286	SURFACE LOOKS LIKE ORIGINAL, NO PITS.
334	09/29/88	BRONZE, FU	LOOKS LIKE NEW. NO PITS.
405	11/09/88	BRONZE, FU	
406	11/09/88	BRONZE, FU	
407	11/09/88	BRONZE, FU	
118	05/16/88	C4340	LIGHT ETCHING SCATTERED OVER SURFACE. NO PITS. SURFACE LOOKS GOOD.
333	09/29/88	C4340	RUST SPOTS SCATTERED OVER ENTIRE FRONT SURFACE. NO DEPTH (OPAQUE). NO PITS.
408	11/09/88	C4340	
335	09/29/88	CDA 101	COUPON IS CORRODED OR HAS PITS VISIBLE WITHOUT MICROSCOPE COVERING BOTH SURFACES THEY ARE 1/64 TO 1/128 INCHES DEEP.
57	05/16/88	HASTELOY X	NO PITS. TOP 1/4 INCHES OF COUPON HAS SEVERE

			ETCHING REMAINING SURFACE LOOKS GOOD
331	09/29/88	NI200	COUPON HAS A CRYSTALLINE GLITTERY SURFACE. NO PITS.
409	11/10/88	NI200	
** WITCO CORP.			ARP-60
64	06/13/88	8740	SURFACE IS DULL. PITTED OVER ENTIRE SURFACE. TOO MANY PITS TO COUNT. AVERAGE DEPTH .0001 INCHES. RUST ON LEFT BOTTOM BACK CORNER. EDGES MORE CORRODED THAN MIDDLE. PICTURE MIGHT BE USEFUL.
68	06/13/88	9310	COUPON SURFACE IS DULL. GRAY FILM OVER ENTIRE COUPON. FILM IS THICK AND ROLLING GRAIN IS NOT VISIBLE THROUGH IT. FILM IS POCKMARKED BUT WHERE FILM HAS WORN OFF SURFACE OF THE METAL HAS NO PITS AND ROLLING GRAIN IS VISIBLE. COUPON SHOULD BE CLEANED BEFORE ACCURATE PIT ANALYSIS CAN BE DONE.
67	06/13/88	A286	GENERAL LIGHT OXIDATION OVER COUPON. SLIGHT DISCOLORATION OVER BACK. NO PITS SURFACE LOOKS LIKE ORIGINAL.
60	06/10/88	C4340	SEVERE CORROSION ON BOTH SURFACES. DIFFICULT TO READ METAL TYPE. ENTIRE SURFACE ROUGH. CANNOT SEE THE ROLLING GRAINS. ENTIRE SURFACE LOOKS CRYSTALLINE. SURFACE DOES NOT LOOK AS ROUGH UNDER THE MICROSCOPE. NO PITS APPARENT.
66	06/13/88	CDA 101	SLIGHT DISCOLORATION ON BACK LEFT SIDE GRAY. BACK MARK GOING TO LIGHT GRAY AS IT MOVES DOWN TO RIGHT FRONT SIDE. ALMOST LOOKS LIKE A WATER MARK. OXIDATION IN UPPER RIGHT CORNER (GREEN). NO PITS.
58	06/10/88	INDIUM	SEVERE GENERAL CORROSION ESPECIALLY AT TOP AND BOTTOM EDGE OF THE COUPON AND AT HOLE. COUPON IS NO LONGER RECTANGULAR. GRAY-WHITE FILM OR SCALE ON BOTH SURFACES. BACK IS MORE CORRODED. NO PITS. SURFACE LOOKS CRYSTALLINE.
61	06/10/88	LEAD	ENTIRE SURFACE COVERED WITH A BLUE GRAY FILM. SURFACE LOOKS CRYSTALLINE. NO MEASURABLE PITS. ABOUT 5 SHADOWS WHICH MIGHT BE PITS OR SURFACE DEFECTS, BUT CANNOT MEASURE DEPTH THROUGH THE FILM. CANNOT SEE ROLLING GRAINS.
63	06/10/88	NI200	SCATTERED ETCHING OVER ENTIRE SURFACE. NO DEPTH. NO PITS. NO ATTACK AT SURFACE DEFECTS.
62	06/10/88	SILVER	ONE AREA OF GENERAL CORROSION/SURFACE DEFECT APPROXIMATELY 1/16 INCHES, DIAMETER 3/8 INCHES UP AND 3/16 INCHES IN FROM FRONT SURFACE. NO PITS.
65	06/13/88	TIN	RIGHT EDGE OF COUPON IS WARPED. LEFT TOP AND BOTTOM CORNERS ARE ROUNDED OFF. ENTIRE SURFACE HAS STRIPS RUNNING LEFT TO RIGHT WHICH LOOKS LIKE THE SURFACE HAS BEEN SHAVED OFF. THESE DEFORMATIONS PENETRATE THE METAL TO

				VARIOUS DEGREES. EACH STRIP IS ABOUT 0.0001 INCHES ABOVE OR BELOW THE STRIP NEXT TO IT. ROLLING GRAIN CAN ONLY BE SEEN IN SMALL AREAS WHERE SHAVING HAS NOT OCCURRED. STRIPS APPEAR GRANULAR UNDER THE MICROSCOPE AND ALTERNATE SHADES OF GRAY. THESE SAME STRIPS HAVE SCRATCHES.
	59	06/13/88	WAX	NA
**	WITCO CORP.			ARP-66
	75	06/09/88	17-4 PH	NO PITS. SURFACE LOOKS LIKE ORIGINAL
	77	06/09/88	309 SS	LIGHT OXIDATION IN CENTER OF FRONT. NO PITS. LOOKS LIKE ORIGINAL.
	76	06/09/88	8740	SLIGHT OXIDATION AROUND HOLE AND NUMBERS. NO PITS. LOOKS LIKE ORIGINAL.
	69	06/09/88	9310	AREA OF SLIGHT ETCHING DIRECTLY BENEATH HOLE. LIGHT OXIDATION OVER SURFACE. ONE PIT. WIDTH 0.0005 INCHES, DEPTH 0.0024 INCHES, SURFACE LOOKS LIKE ORIGINAL STATE.
	78	06/09/88	A286	SURFACE LOOKS LIKE ORIGINAL. NO PITS.
	399	11/15/88	BRONZE, FU	
	74	06/08/88	C4340	ORANGE DISCOLORATION OVER FRONT AND BACK. MIDDLE, FRONT IS PINK GREEN AND BLUE. APPROXIMATELY 44 PITS. ONE PIT IS 0.04 INCHES BY 0.04 INCHES AND ROUND BUT IT GOES ALL THE WAY THROUGH THE COUPON. WIDTH RANGE FOR OTHERS IS 0.08 INCHES TO 0.28 INCHES, AVERAGE WIDTH IS 0.18 INCHES, DEPTH RANGE .0001 INCHES TO .0409 INCHES, AVERAGE DEPTH .0205 INCHES, PITS OCCUR IN AREAS OF HEAVIEST DISCOLORATION.
	402	11/15/88	C4340	
	403	11/15/88	C4340	
	145	06/08/88	CADMIUM	COUPON THIN WITH LEFT SIDE THINNER THAN RIGHT. GRAY AND BROWN SCALE COVERS SURFACE AND COMES OFF AS A POWDER. LIGHT ETCHING OVER SURFACE AND IS ACCOMPANIED BY WHITE CRYSTALS ON SURFACE. NO PITS. GRAY DISCOLORATION ALL OVER.
	71	06/08/88	CDA 101	COUPON IS SLIGHTLY WARPED. DARK BROWN FILM COVERS SURFACE. FILM COMES OFF AS A POWDER ON CONTACT. SURFACE UNDER FILM IS DISCOLORED ORANGE. FILM COVERING AND DISCOLORED PINK AND YELLOW ARE 0.4 INCHES BY .08 INCHES. GRAIN IS VISIBLE THROUGH FILM. NO PITS
	400	11/15/88	CDA 101	
	401	11/15/88	CDA 101	
	70	06/08/88	INDIUM	COUPON IS SLIGHTLY WARPED. DARK BROWN FILM COVERS SURFACE. FILM COMES OFF AS A POWDER ON CONTACT. SURFACE UNDER FILM IS DISCOLORED ORANGE. FILM IS THICK BUT ONE AREA OF FRONT MIDDLE IS WITHOUT A FILM COVERING AND DISCOLORED PINK AND YELLOW-0.4 INCHES BY .08 INCHES. GRAIN IS VISIBLE THROUGH FILM. NO PITS.
	72	06/08/88	LEAD	COUPON IS WARPED AND DOES NOT LAY FLAT.

		COUPON COVERED WITH WHITE FILM. WHITE POWDERY FILM ALONG BOTTOM EDGE (FRONT AND BACK). BEIGE DISCOLORATION ALONG LEFT AND RIGHT EDGES. BENEATH GRAY FILM WHITE CRYSTALS ARE APPARENT WITH MICROSCOPE. ROLLING GRAIN NOT VISIBLE IN BEIGE AREAS AND THESE AREAS ARE WORN DOWN AN AVERAGE OF 0.0104 INCHES BELOW THE REST OF COUPON SURFACE. THERE ARE THREE AREAS WITH NO FILM COVERING ON FRONT BUT THE METAL HERE IS DISCOLORED BLUE YELLOW AND RED.
73	06/08/88 NI200	OLIVE GREEN SCALE ACROSS FRONT TOP AND DOWN RIGHT SIDE. LEFT EDGE FRONT DISCOLORED BLACK. BLACK AREAS HAVE NO DEPTH BUT ROLLING GRAIN IS NOT APPARENT IN THESE AREAS. GREEN SCALE IS CRYSTALLINE. LIGHT ETCHING OVER SURFACE UNDER SCALE IS YELLOW PINK BLUE AND GREEN. NO PITS.
404	11/15/88 NI200	

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APPENDIX E

STRIPPING PERFORMANCE RESULTS
FOR A COMMON STRIPPER, AND BIODEGRADABILITY DATA

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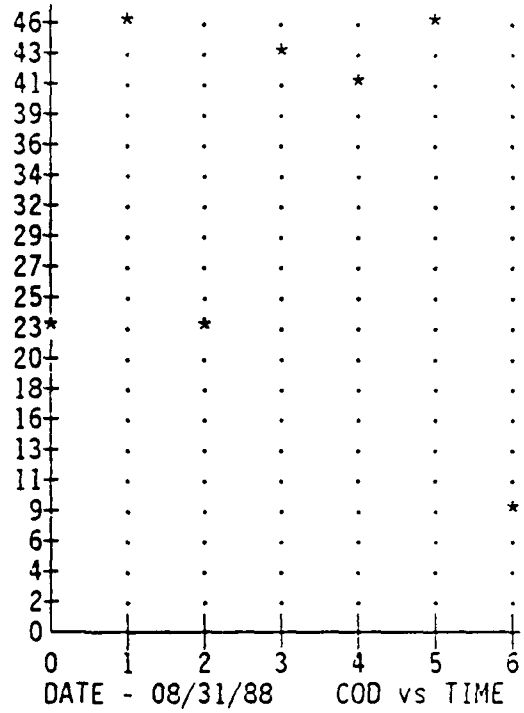
CIRCUIT CHEM. CORP. CIRSTRIP NON-CU A.B

MATERIAL	STRIPPING RATE (mils/hr)
17-4 PH	BDL
17-4 PH	BDL
309 SS	BDL
316 SS	BDL
410 SS	BDL
410 SS	BDL
8740	BDL
8740	1.00E-4
8740	1.00E-4
8740	1.00E-4
9310	2.40E-3
9310	BDL
9310	BDL
9310	BDL
A286	BDL
AL 1100	BDL
BRONZE, FUMING	4.88E0
BRONZE, FUMING	BDL
C276	BDL

MATERIAL	STRIPPING RATE (mils/hr)
C276	BDL
C4340	BDL
C4340	BDL
CADMIUM	1.73E-1
CADMIUM	5.59E-2
CDA 101	5.64E0
CDA 101	7.10E0
CHROMIUM	BDL
HASTELOY X	1.00E-4
INCONEL 625	BDL
INCONEL 625	BDL
INDIUM	8.52E-2
INDIUM	7.65E-2
LEAD	BDL
NI200	BDL
NI200	6.00E-4
SILVER	1.86E-1
TIN	BDL

CIRCUIT CHEM. CORP.
CIRSTRIP NCN-CU A,B
PART A

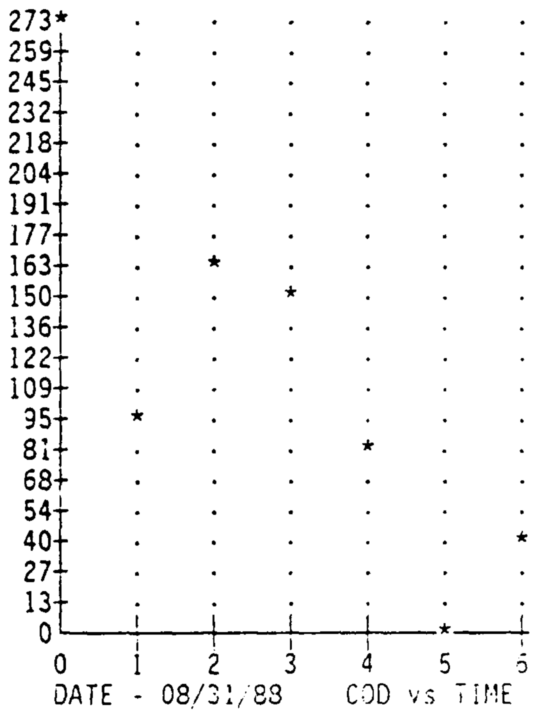


0-	24
1-	46
2-	24
3-	44
4-	41
5-	45
6-	9

DRY
WEIGHT
0.0811

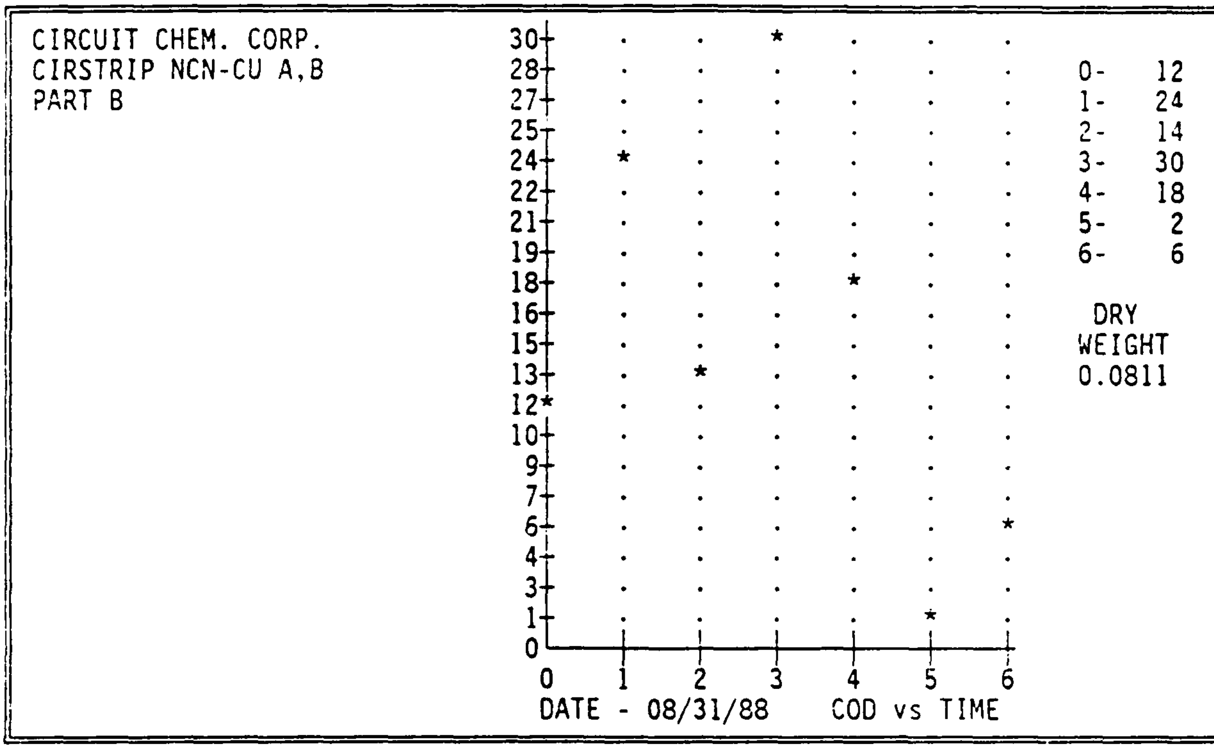
PHENOL
08/31/88
ATP - 297 E-8

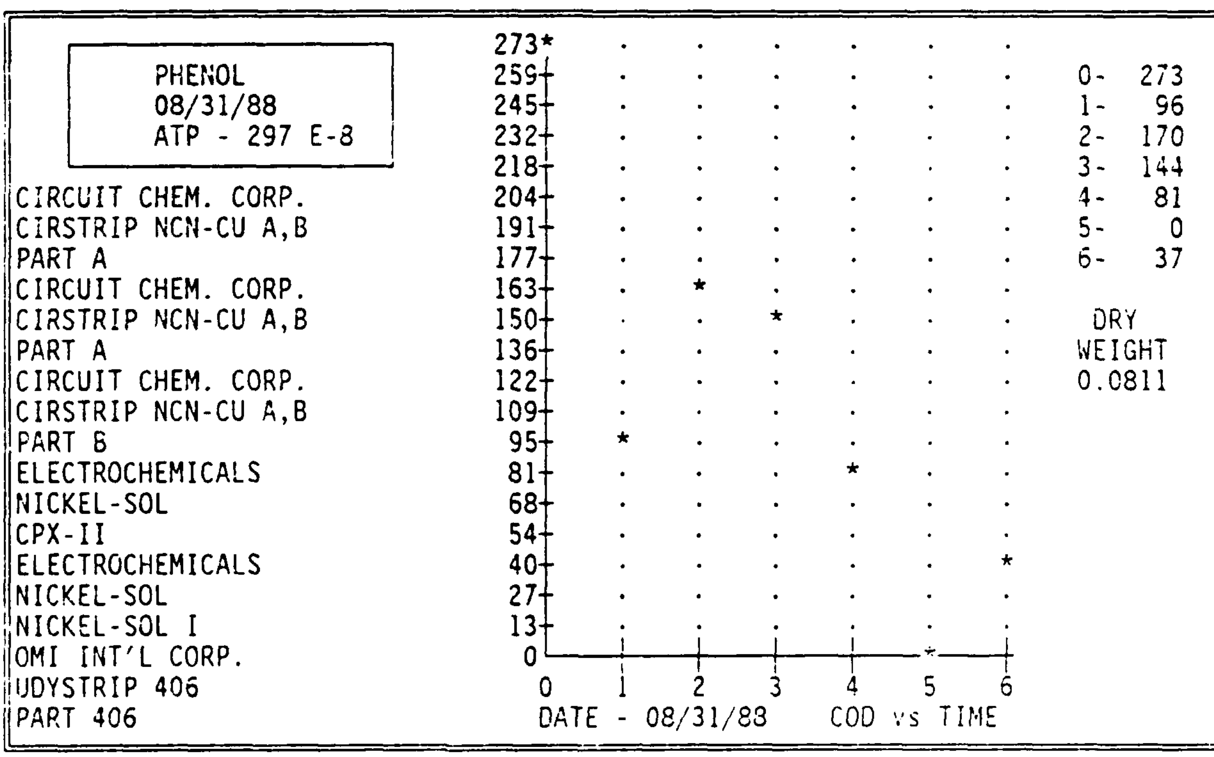
CIRCUIT CHEM. CORP.
CIRSTRIP NCN-CU A,B
PART A
CIRCUIT CHEM. CORP.
CIRSTRIP NCN-CU A,B
PART A
CIRCUIT CHEM. CORP.
CIRSTRIP NCN-CU A,B
PART B
ELECTROCHEMICALS
NICKEL-SOL
CPX-II
ELECTROCHEMICALS
NICKEL-SOL
NICKEL-SOL I
OMI INT'L CORP.
UDYSTRIP 406
PART 406

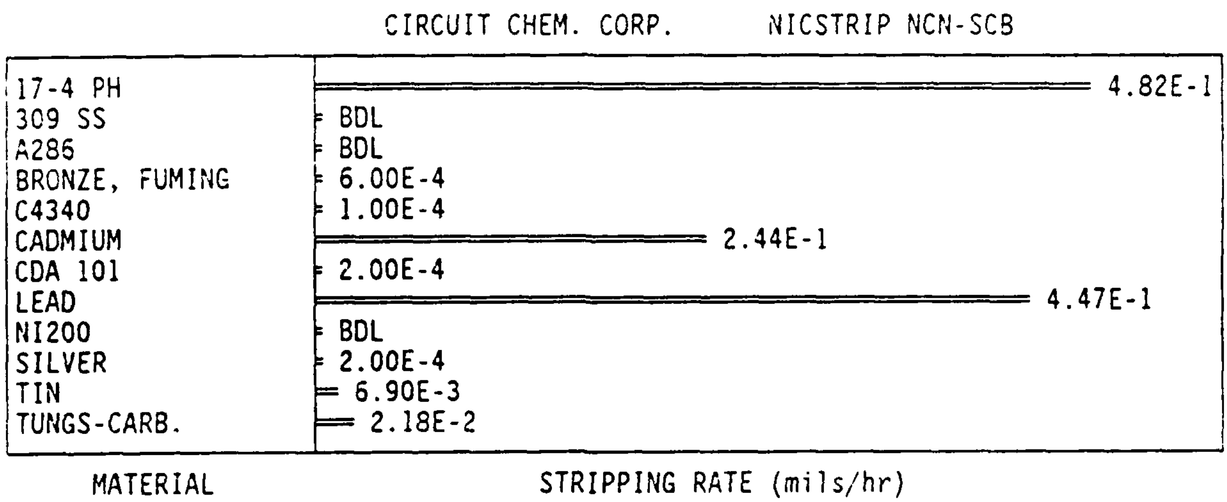


0-	273
1-	96
2-	170
3-	144
4-	81
5-	0
6-	37

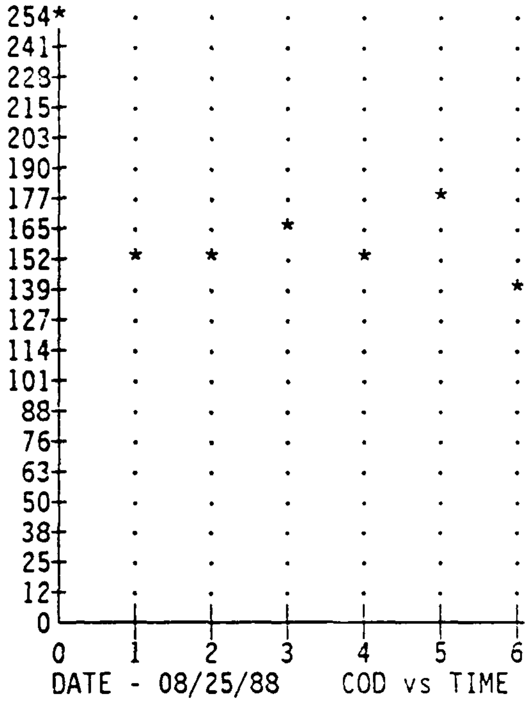
DRY
WEIGHT
0.0811


CIRCUIT CHEM. CORP.
CIRSTRIP NCN-CU A,B
PART B
30
28
27
25
24
22
21
19
18
16
15
13
12
10
9
7
6
4
3
1
0
0 1 2 3 4 5 6
DATE - 08/31/88 COD vs TIME
0- 12
1- 24
2- 14
3- 30
4- 18
5- 2
6- 6
DRY
WEIGHT
0.0811


PHENOL
08/31/88
ATP - 297 E-8
CIRCUIT CHEM. CORP.
CIRSTRIP NCN-CU A,B
PART A
CIRCUIT CHEM. CORP.
CIRSTRIP NCN-CU A,B
PART A
CIRCUIT CHEM. CORP.
CIRSTRIP NCN-CU A,B
PART B
ELECTROCHEMICALS
NICKEL-SOL
CPX-II
ELECTROCHEMICALS
NICKEL-SOL
NICKEL-SOL I
OMI INT'L CORP.
UDYSTRIP 406
PART 406
273
259
245
232
218
204
191
177
163
150
136
122
109
95
81
68
54
40
27
13
0
0 1 2 3 4 5 6
DATE - 08/31/88 COD vs TIME
0- 273
1- 96
2- 170
3- 144
4- 81
5- 0
6- 37
DRY
WEIGHT
0.0811


CIRCUIT CHEM. CORP.
NICSTRIP NCN-SCB
17-4 PH
4.82E-1
309 SS
BDL
A286
BDL
BRONZE, FUMING
6.00E-4
C4340
1.00E-4
CADMIUM
2.44E-1
CDA 101
2.00E-4
LEAD
4.47E-1
NI200
BDL
SILVER
2.00E-4
TIN
6.90E-3
TUNGS-CARB.
2.18E-2
MATERIAL
STRIPPING RATE (mils/hr)

CIRCUIT CHEM. CORP.
NICSTRIP NCN-SCB
PART 1

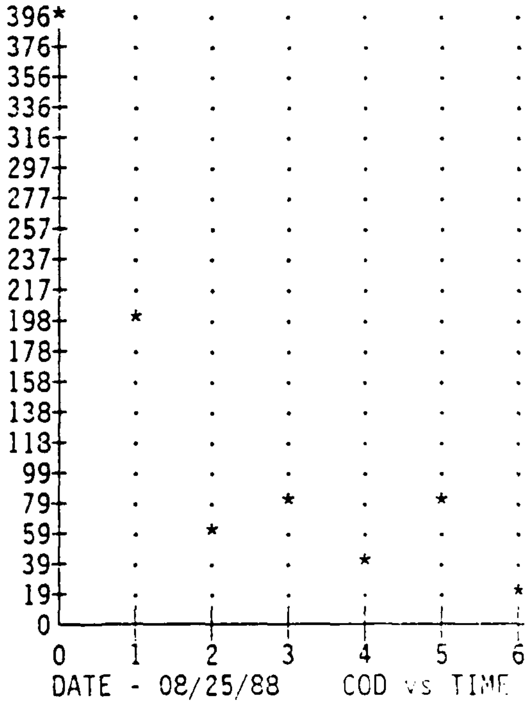


0-	254
1-	153
2-	151
3-	160
4-	157
5-	176
6-	138

DRY
WEIGHT
0.0887

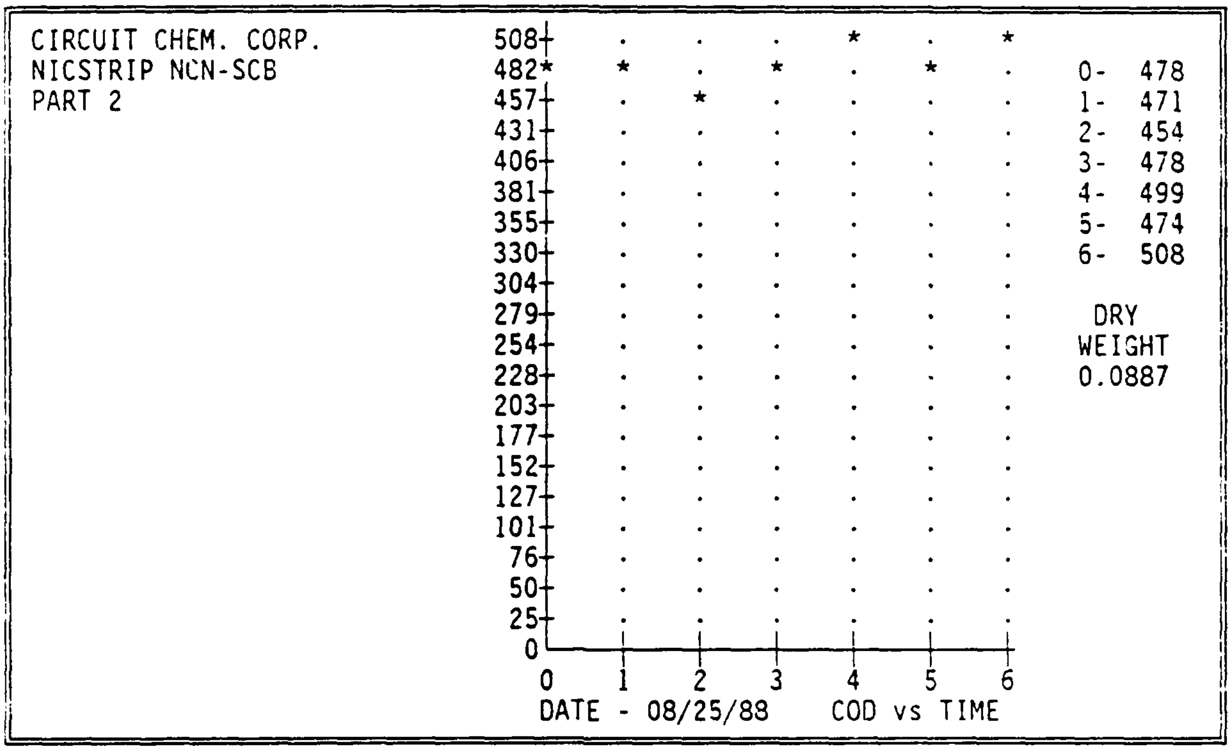
PHENOL
08/25/88
ATP - 43 E-8

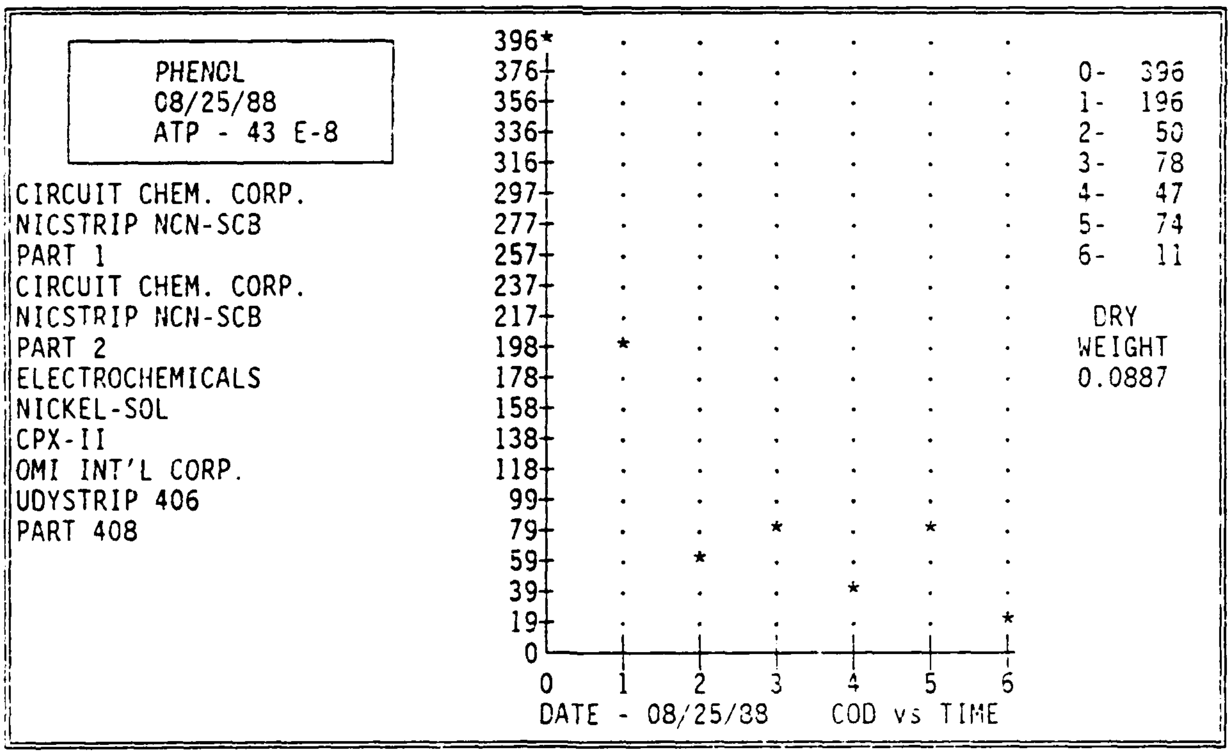
CIRCUIT CHEM. CORP.
NICSTRIP NCN-SCB
PART 1
CIRCUIT CHEM. CORP.
NICSTRIP NCN-SCB
PART 2
ELECTROCHEMICALS
NICKEL-SOL
CPX-II
OMI INT'L CORP.
UDYSTRIP 406
PART 408

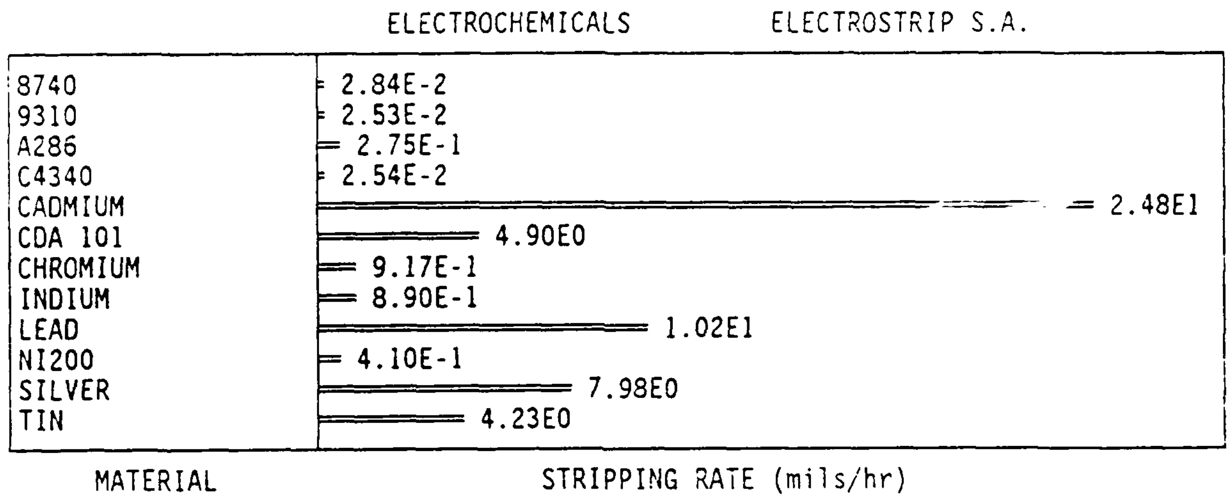


0-	396
1-	196
2-	50
3-	78
4-	47
5-	74
6-	11

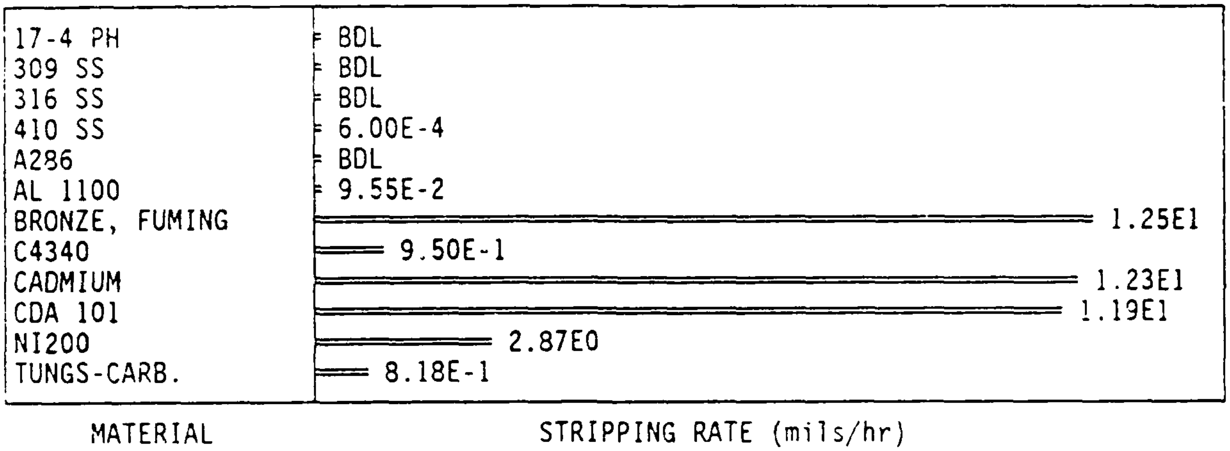
DRY
WEIGHT
0.0887


CIRCUIT CHEM. CORP.
NICSTRIP NCN-SCB
PART 2
508 482 457 431 406 381 355 330 304 279 254 228 203 177 152 127 101 76 50 25 0
0 1 2 3 4 5 6
DATE - 08/25/88 COD vs TIME
0- 478
1- 471
2- 454
3- 478
4- 499
5- 474
6- 508
DRY
WEIGHT
0.0887

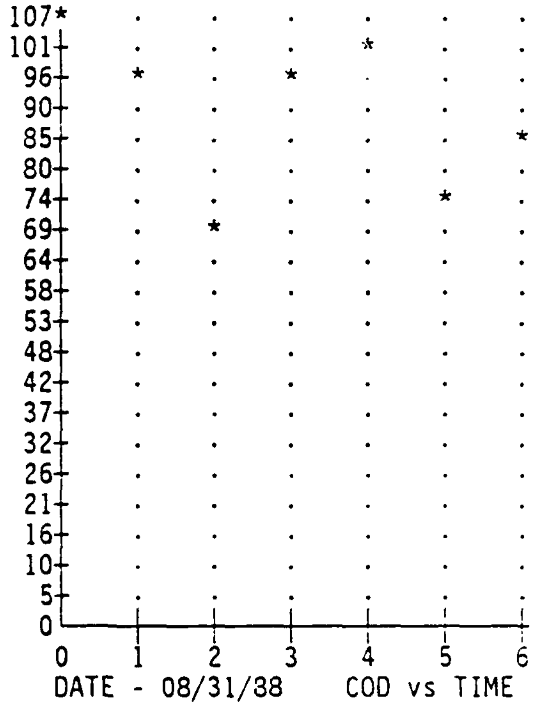

PHENOL
08/25/88
ATP - 43 E-8
CIRCUIT CHEM. CORP.
NICSTRIP NCN-SCB
PART 1
CIRCUIT CHEM. CORP.
NICSTRIP NCN-SCB
PART 2
ELECTROCHEMICALS
NICKEL-SOL
CPX-II
OMI INT'L CORP.
UDYSTRIP 406
PART 408
396 376 356 336 316 297 277 257 237 217 198 178 158 138 118 99 79 59 39 19 0
0 1 2 3 4 5 6
DATE - 08/25/88 COD vs TIME
0- 396
1- 196
2- 50
3- 78
4- 47
5- 74
6- 11
DRY
WEIGHT
0.0887


ELECTROCHEMICALS ELECTROSTRIP S.A.
8740 2.84E-2
9310 2.53E-2
A286 2.75E-1
C4340 2.54E-2
CADMIUM 2.48E1
CDA 101 4.90E0
CHROMIUM 9.17E-1
INDIUM 8.90E-1
LEAD 1.02E1
NI200 4.10E-1
SILVER 7.98E0
TIN 4.23E0
MATERIAL
STRIPPING RATE (mils/hr)

ELECTROCHEMICALS NICKEL-SOL



ELECTROCHEMICALS
NICKEL-SOL
NICKEL-SOL I

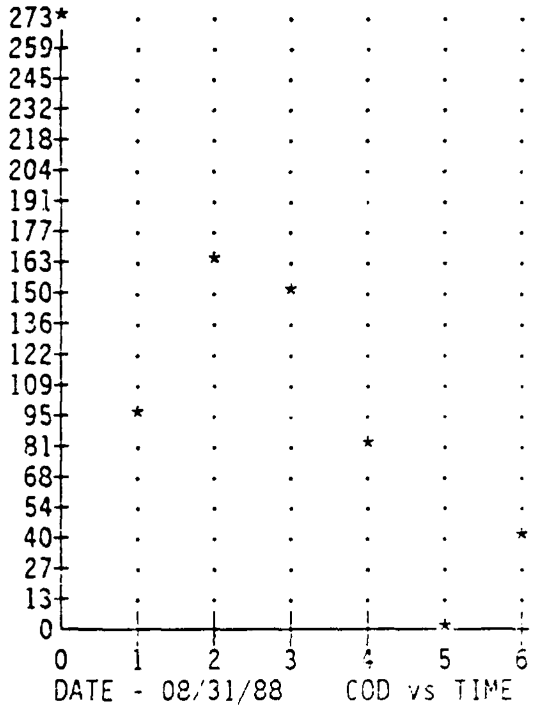


0-	107
1-	96
2-	69
3-	95
4-	104
5-	74
6-	88

DRY
WEIGHT
0.0811

PHENOL
08/31/88
ATP - 297 E-8

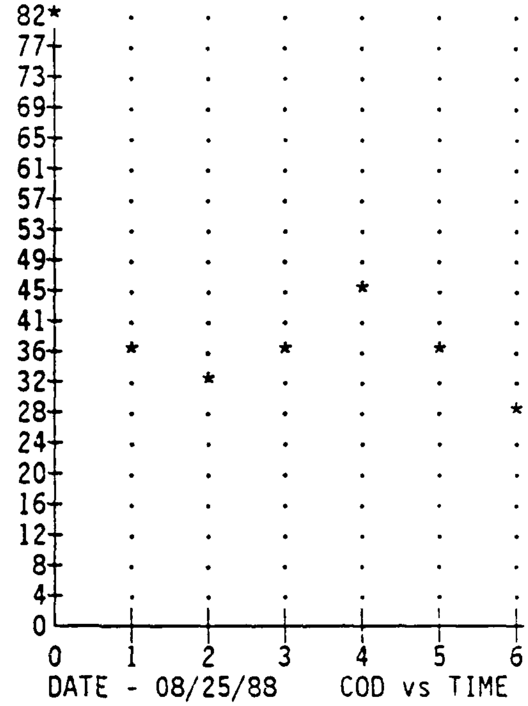
CIRCUIT CHEM. CORP.
CIRSTRIP NCN-CU A,B
PART A
CIRCUIT CHEM. CORP.
CIRSTRIP NCN-CU A,B
PART A
CIRCUIT CHEM. CORP.
CIRSTRIP NCN-CU A,B
PART B
ELECTROCHEMICALS
NICKEL-SOL
CPX-II
ELECTROCHEMICALS
NICKEL-SOL
NICKEL-SOL I
OMI INT'L CORP.
UDYSTRIP 406
PART 406



0-	273
1-	95
2-	170
3-	144
4-	81
5-	0
6-	37

DRY
WEIGHT
0.0811

ELECTROCHEMICALS
NICKEL-SOL
CPX-II

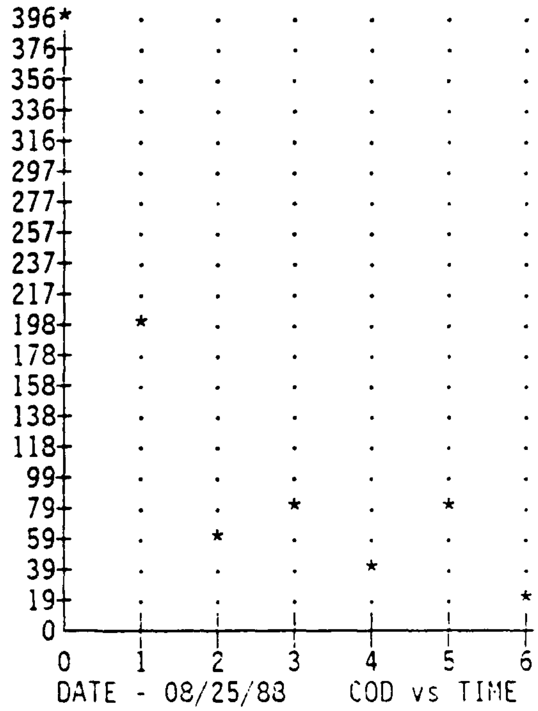


0- 82
1- 36
2- 32
3- 36
4- 44
5- 36
6- 30

DRY
WEIGHT
0.0887

PHENOL
08/25/88
ATP - 43 E-8

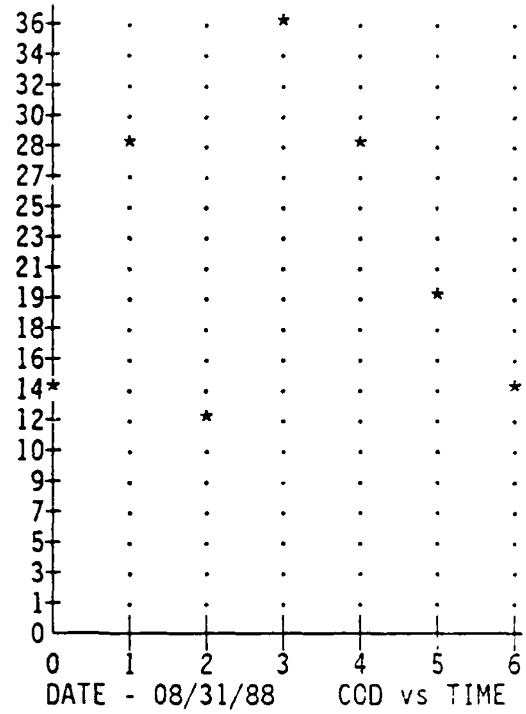
CIRCUIT CHEM. CORP.
NICSTRIP NCN-SCB
PART 1
CIRCUIT CHEM. CORP.
NICSTRIP NCN-SCB
PART 2
ELECTROCHEMICALS
NICKEL-SOL
CPX-II
OMI INT'L CORP.
UDYSTRIP 406
PART 408



0- 396
1- 196
2- 50
3- 78
4- 47
5- 74
6- 11

DRY
WEIGHT
0.0887

ELECTROCHEMICALS
NICKEL-SOL
CPX-II

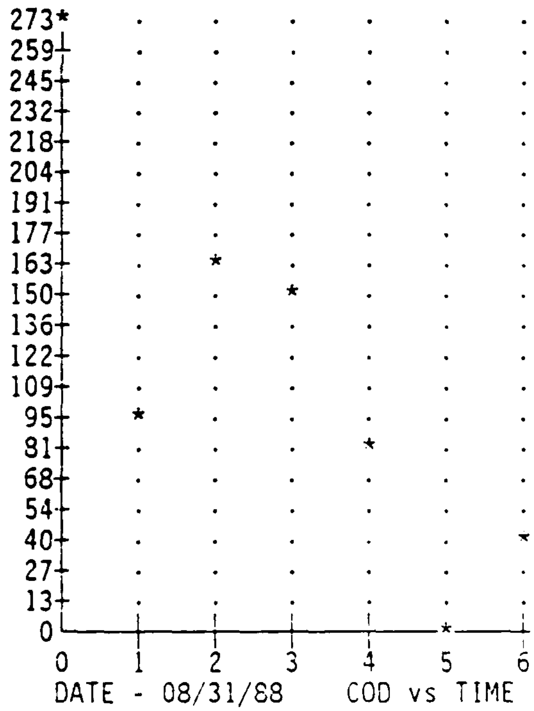


0- 14
1- 29
2- 13
3- 36
4- 28
5- 19
6- 15

DRY WEIGHT 0.0811

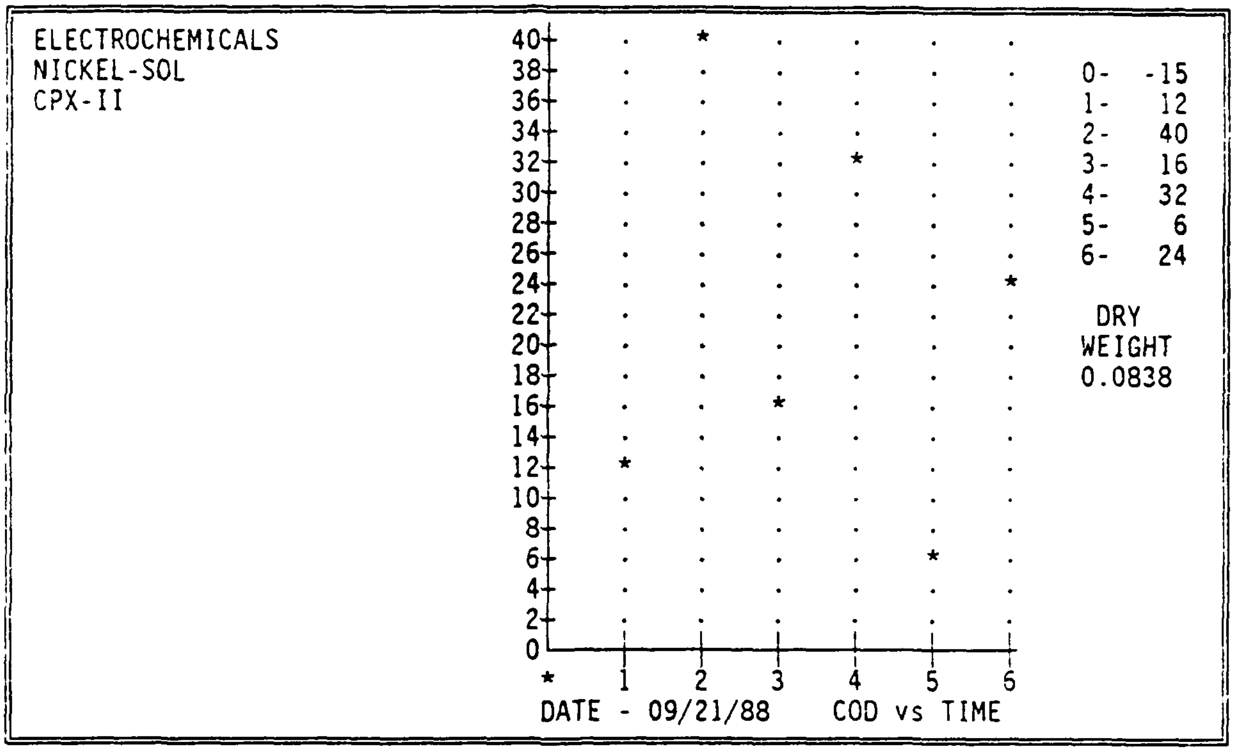
PHENOL
08/31/88
ATP - 297 E-8

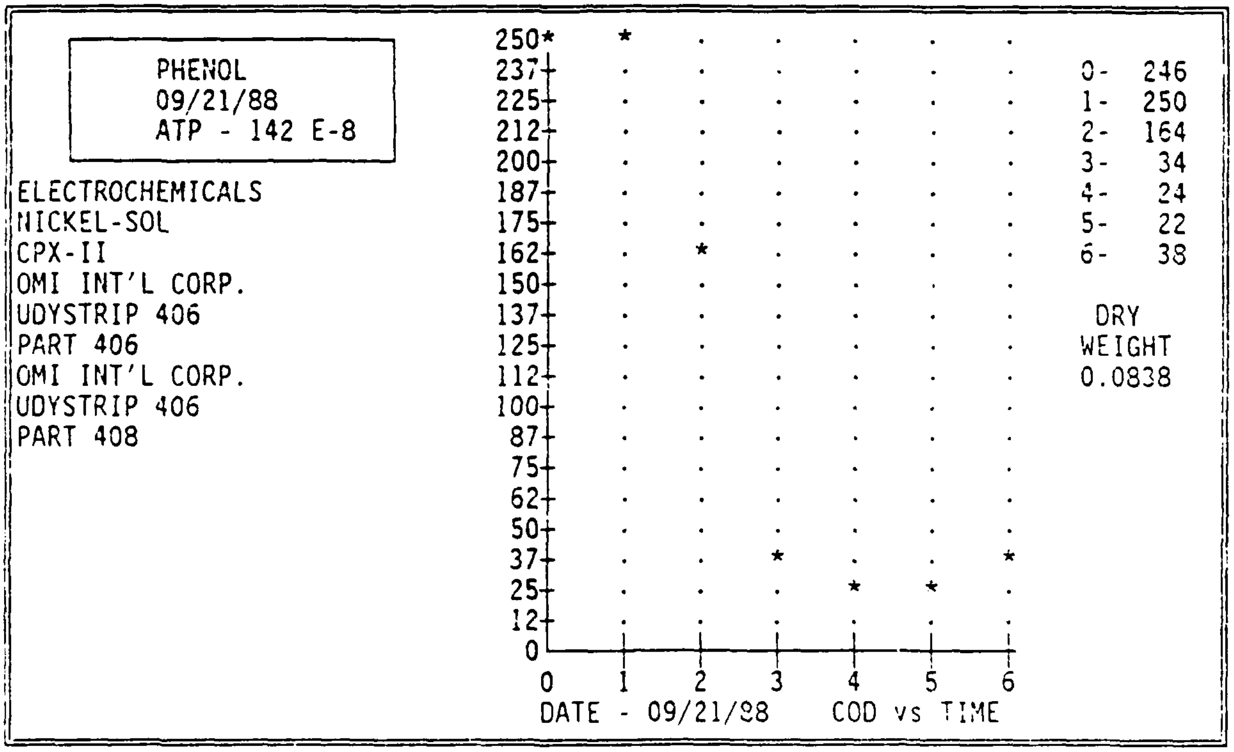
CIRCUIT CHEM. CORP.
CIRSTRIP NCN-CU A,B
PART A
CIRCUIT CHEM. CORP.
CIRSTRIP NCN-CU A,B
PART A
CIRCUIT CHEM. CORP.
CIRSTRIP NCN-CU A,B
PART B
ELECTROCHEMICALS
NICKEL-SOL
CPX-II
ELECTROCHEMICALS
NICKEL-SOL
NICKEL-SOL I
OMI INT'L CORP.
UDYSTRIP 406
PART 406



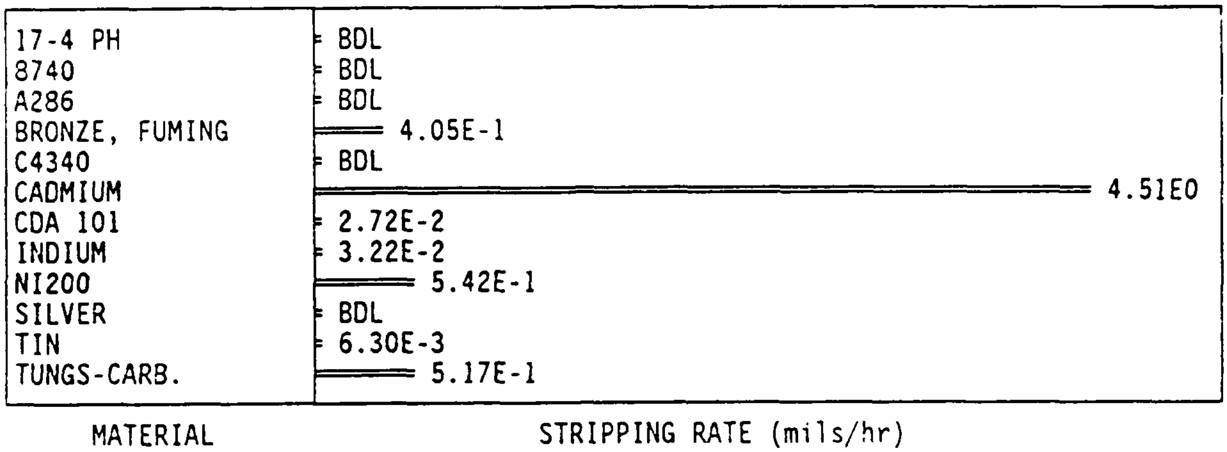
0- 273
1- 96
2- 170
3- 144
4- 81
5- 0
6- 37

DRY WEIGHT 0.0811

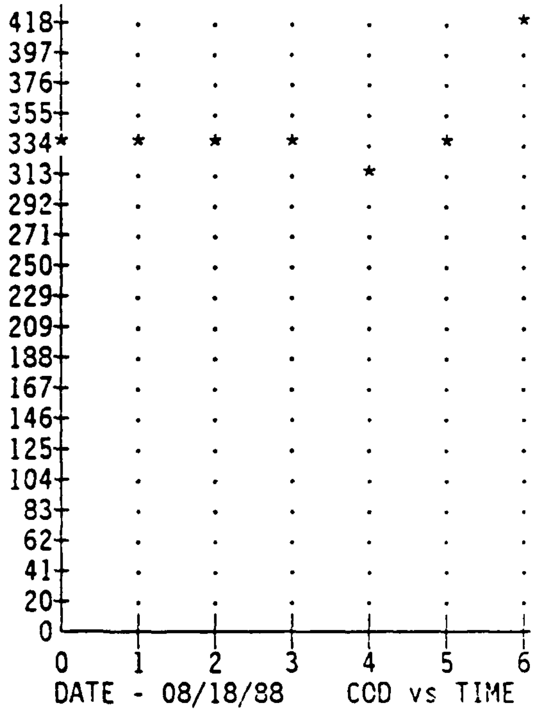

ELECTROCHEMICALS
NICKEL-SOL
CPX-II
0- -15
1- 12
2- 40
3- 16
4- 32
5- 6
6- 24
DRY
WEIGHT
0.0838
DATE - 09/21/88 COD vs TIME


PHENOL
09/21/88
ATP - 142 E-8
ELECTROCHEMICALS
NICKEL-SOL
CPX-II
OMI INT'L CORP.
UDYSTRIP 406
PART 406
OMI INT'L CORP.
UDYSTRIP 406
PART 408
0- 246
1- 250
2- 164
3- 34
4- 24
5- 22
6- 38
DRY
WEIGHT
0.0838
DATE - 09/21/88 COD vs TIME

FREDRICK GUMM CHEM. CLEPO 204 (IMMERSION)



FREDRICK GUMM CHEM.
CLEPO 204 (IMMERSION)
PART N



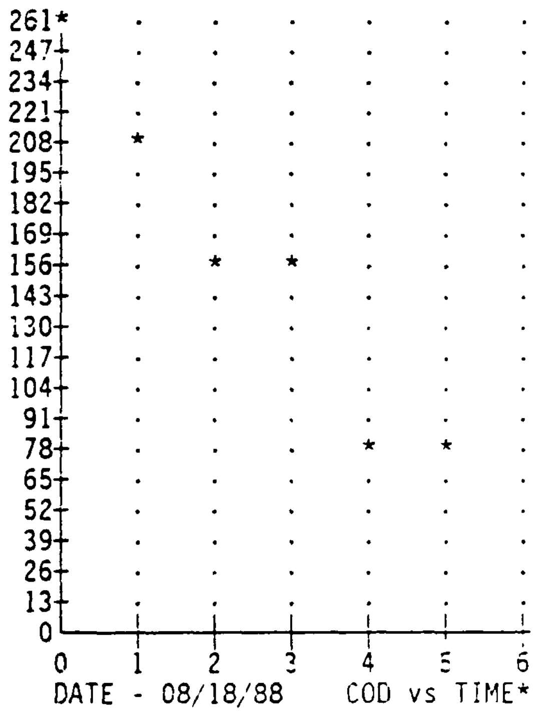
0- 330
1- 340
2- 326
3- 325
4- 316
5- 331
6- 418

DRY
WEIGHT
0.0504

PHENOL
08/18/88
ATP - 167 E-8

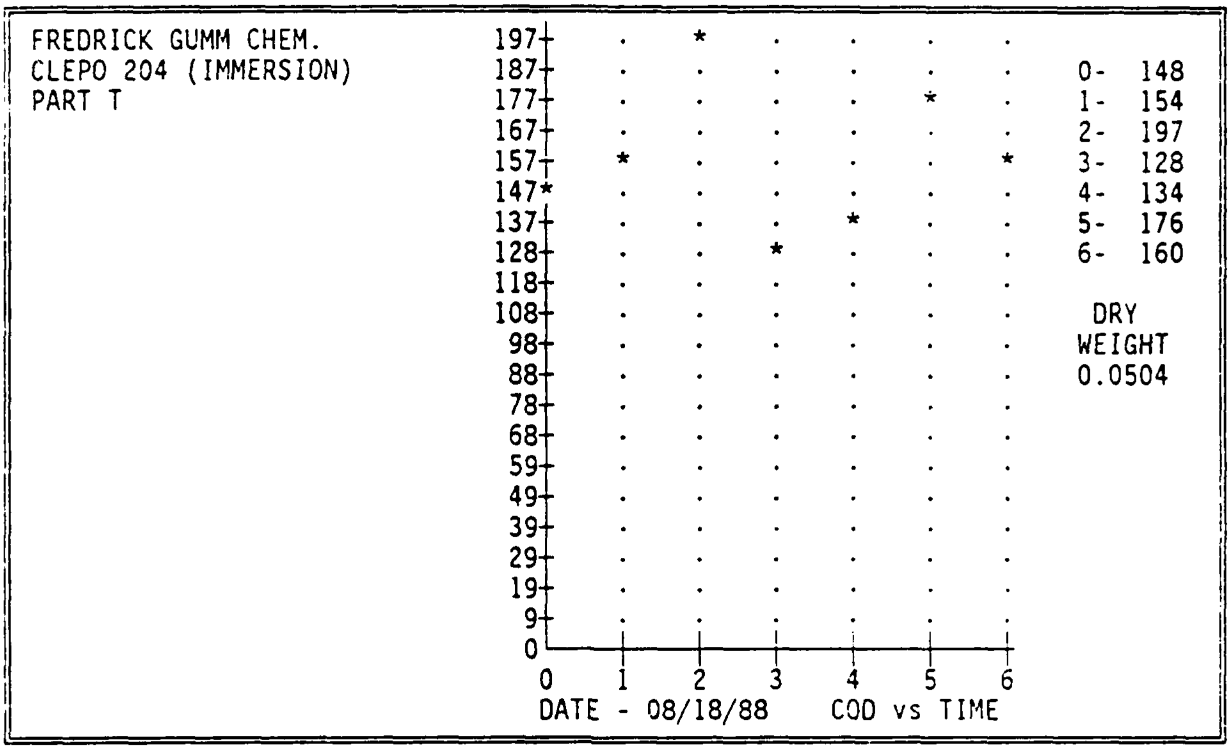
FREDRICK GUMM CHEM.
CLEPO 204 (IMMERSION)
PART N
FREDRICK GUMM CHEM.
CLEPO 204 (IMMERSION)
PART T
METALLINE CHEM CORP.
6400 (NI)

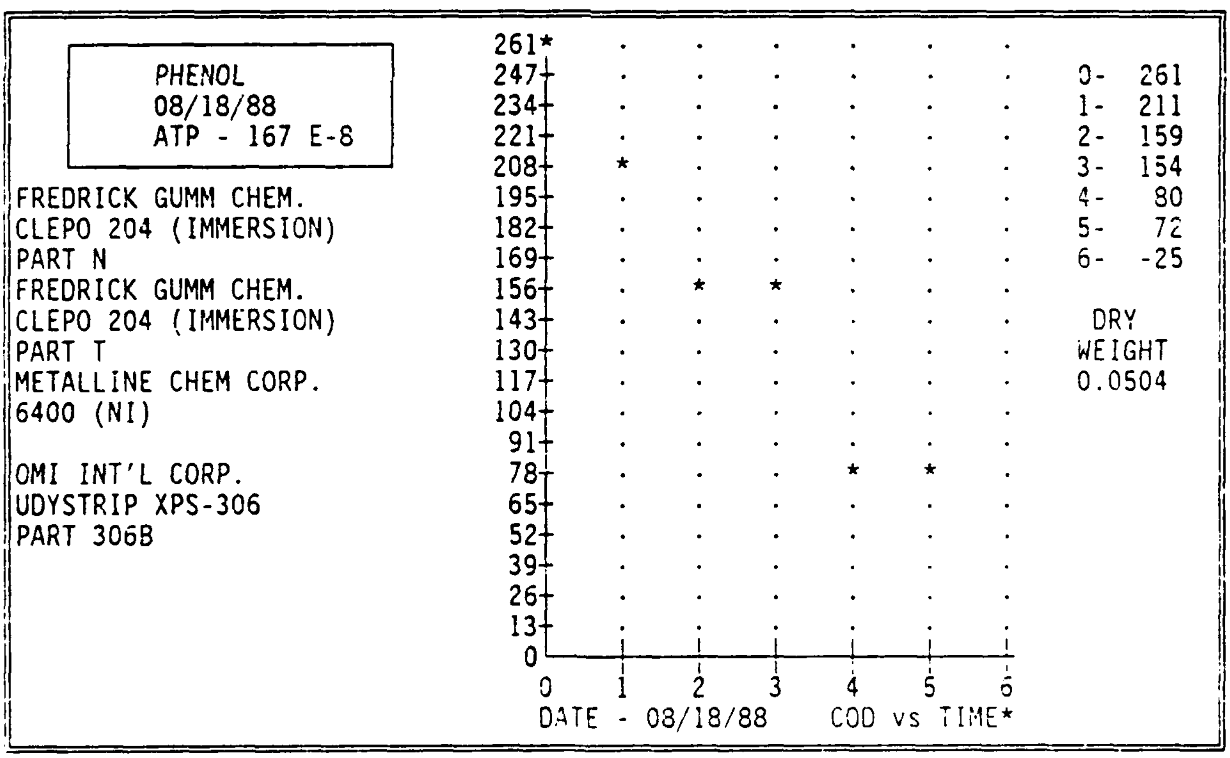
OMI INT'L CORP.
UDYSTRIP XPS-306
PART 306B



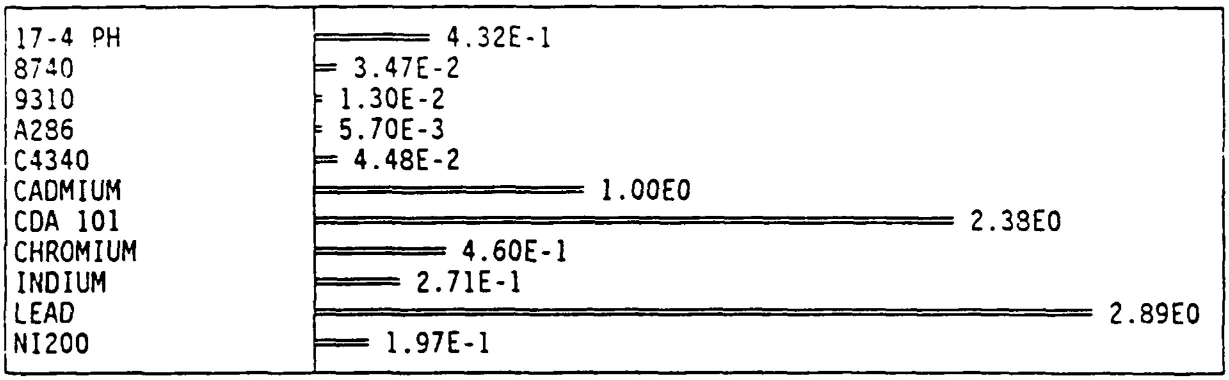
0- 261
1- 211
2- 159
3- 154
4- 90
5- 72
6- -25

DRY
WEIGHT
0.0504

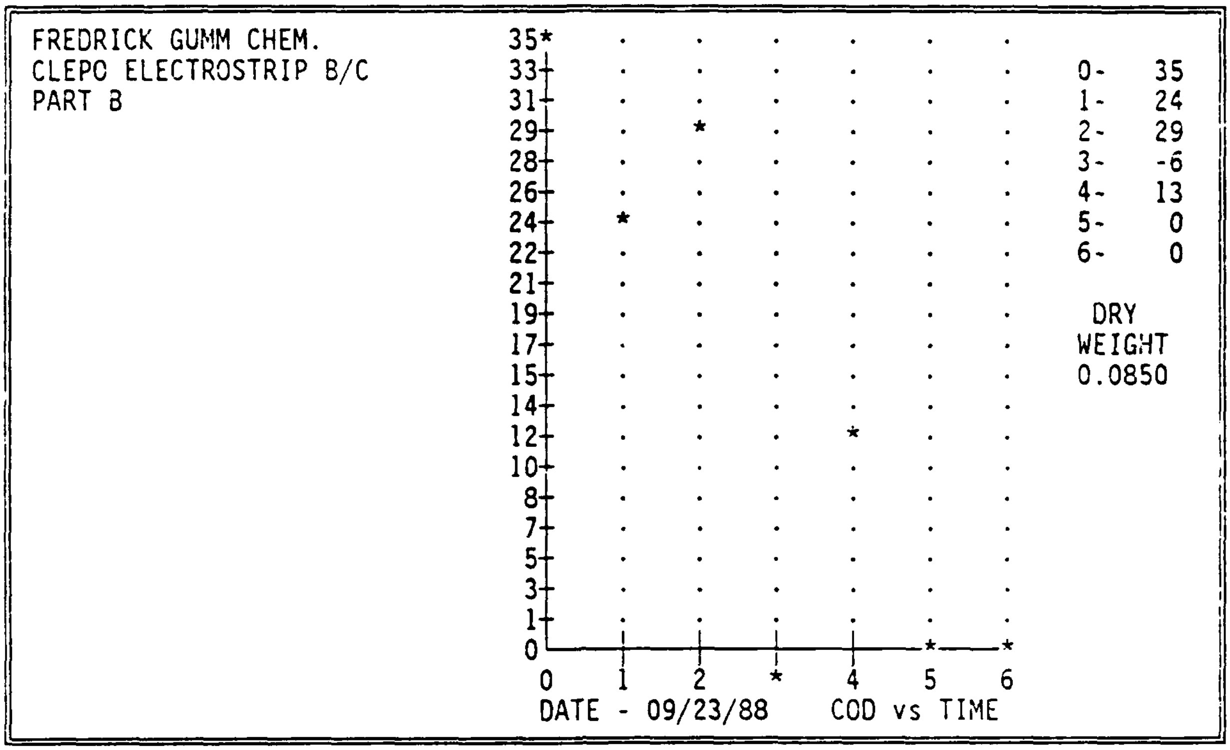

FREDRICK GUMM CHEM.
CLEPO 204 (IMMERSION)
PART T
197
187
177
167
157
147
137
128
118
108
98
88
78
68
59
49
39
29
19
9
0
0 1 2 3 4 5 6
DATE - 08/18/88 COD vs TIME
0- 148
1- 154
2- 197
3- 128
4- 134
5- 176
6- 160
DRY
WEIGHT
0.0504

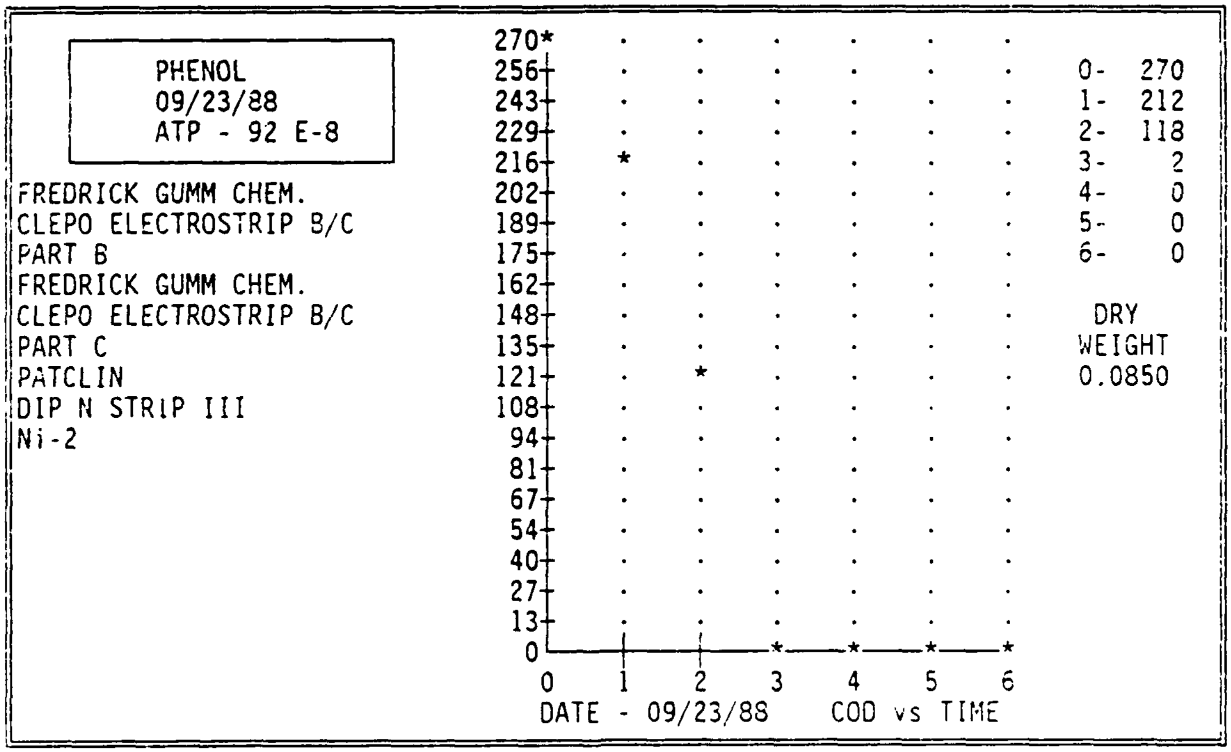

PHENOL
08/18/88
ATP - 167 E-8
FREDRICK GUMM CHEM.
CLEPO 204 (IMMERSION)
PART N
FREDRICK GUMM CHEM.
CLEPO 204 (IMMERSION)
PART T
METALLINE CHEM CORP.
6400 (NI)
OMI INT'L CORP.
UDYSTRIP XPS-306
PART 306B
261
247
234
221
208
195
182
169
156
143
130
117
104
91
78
65
52
39
26
13
0
0 1 2 3 4 5 6
DATE - 08/18/88 COD vs TIME*
0- 261
1- 211
2- 159
3- 154
4- 80
5- 72
6- -25
DRY
WEIGHT
0.0504

FREDRICK GUMM CHEM.   CLEPO ELECTROSTRIP B/C

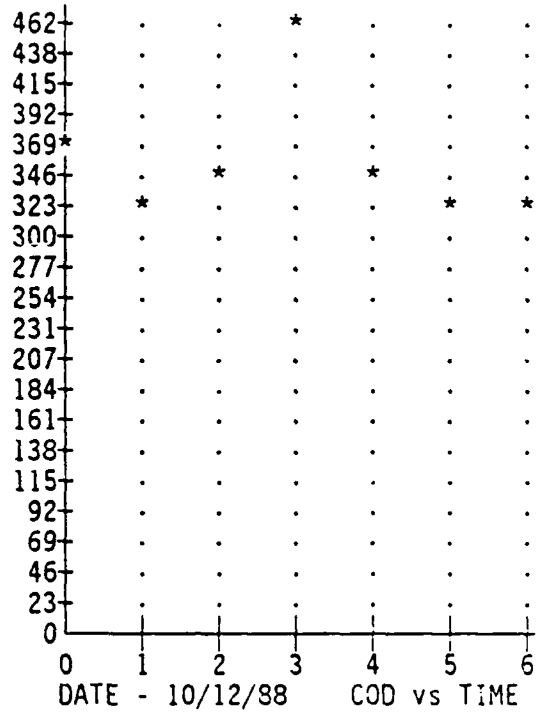


MATERIAL   STRIPPING RATE (mils/hr)


FREDRICK GUMM CHEM.
CLEPO ELECTROSTRIP B/C
PART B
35
33
31
29
28
26
24
22
21
19
17
15
14
12
10
8
7
5
3
1
0
0 1 2 * 4 5 6
DATE - 09/23/88 COD vs TIME
0- 35
1- 24
2- 29
3- -6
4- 13
5- 0
6- 0
DRY
WEIGHT
0.0850


PHENOL
09/23/88
ATP - 92 E-8
FREDRICK GUMM CHEM.
CLEPO ELECTROSTRIP B/C
PART B
FREDRICK GUMM CHEM.
CLEPO ELECTROSTRIP B/C
PART C
PATCLIN
DIP N STRIP III
Ni-2
270
256
243
229
216
202
189
175
162
148
135
121
108
94
81
67
54
40
27
13
0
0 1 2 3 4 5 6
DATE - 09/23/88 COD vs TIME
0- 270
1- 212
2- 118
3- 2
4- 0
5- 0
6- 0
DRY
WEIGHT
0.0850

FREDRICK GUMM CHEM.
CLEPO ELECTROSTRIP B/C
PART B

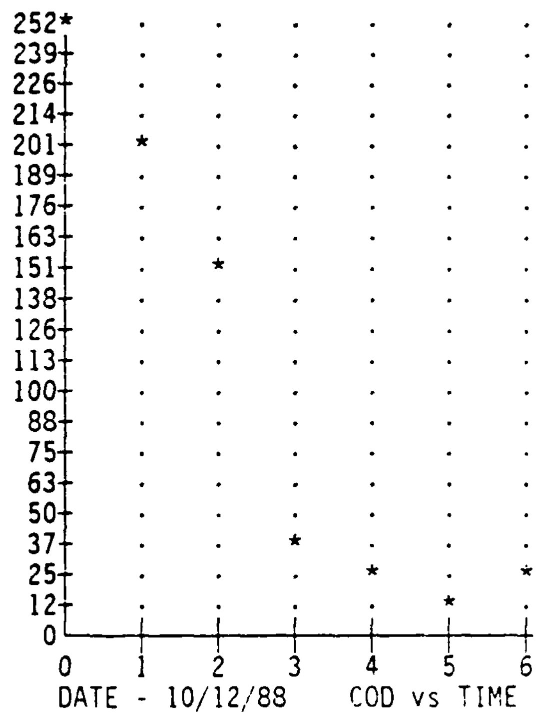


0- 359
1- 330
2- 358
3- 462
4- 340
5- 324
6- 332

DRY
WEIGHT
0.0702

PHENOL
10/12/88
ATP - 131 E-8

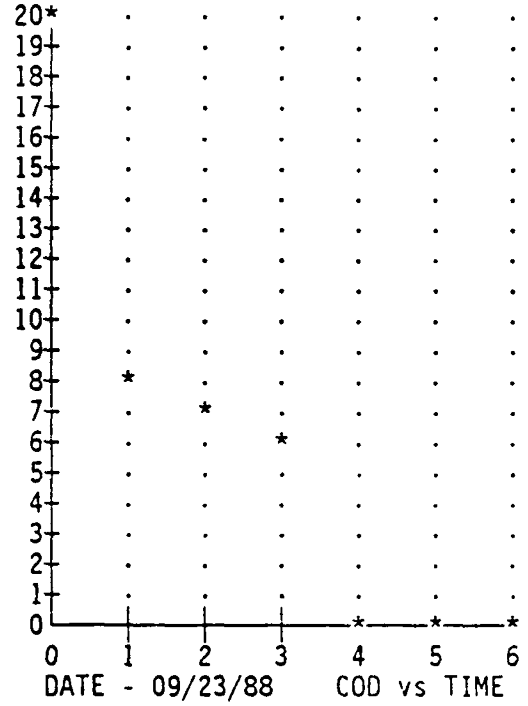
FREDRICK GUMM CHEM.
CLEPO ELECTROSTRIP B/C
PART B



0- 252
1- 206
2- 148
3- 36
4- 30
5- 10
6- 20

DRY
WEIGHT
0.0702

FREDRICK GUMM CHEM.
CLEPO ELECTROSTRIP B/C
PART C

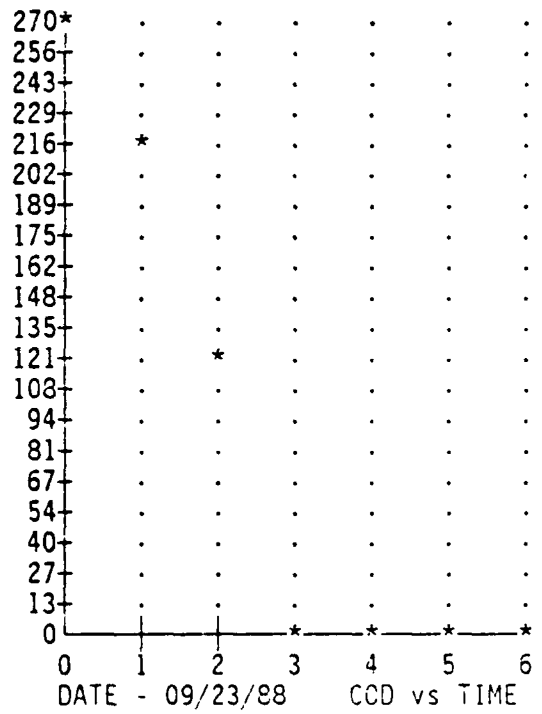


0- 20
1- 8
2- 7
3- 6
4- 0
5- 0
6- 0

DRY
WEIGHT
0.0850

PHENOL
09/23/88
ATP - 92 E-8

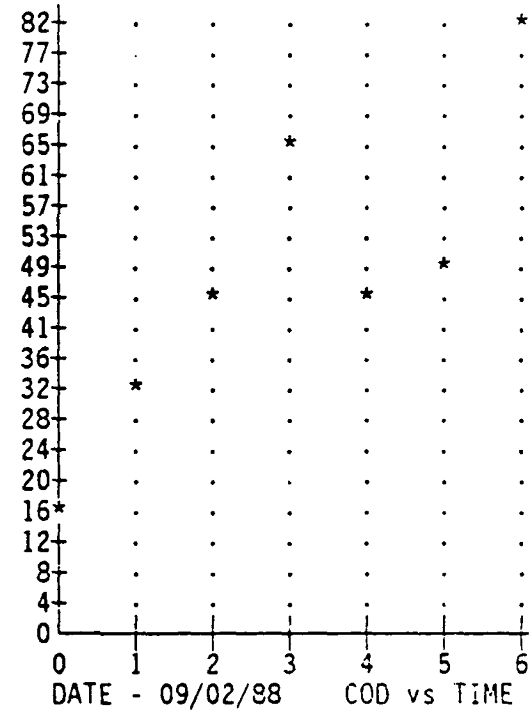
FREDRICK GUMM CHEM.
CLEPO ELECTROSTRIP B/C
PART B
FREDRICK GUMM CHEM.
CLEPO ELECTROSTRIP B/C
PART C
PATCLIN
DIP N STRIP III
Ni-2



0- 270
1- 212
2- 118
3- 2
4- 0
5- 0
6- 0

DRY
WEIGHT
0.0850

FREDRICK GUMM CHEM.
CLEPO ELECTROSTRIP B/C
PART C



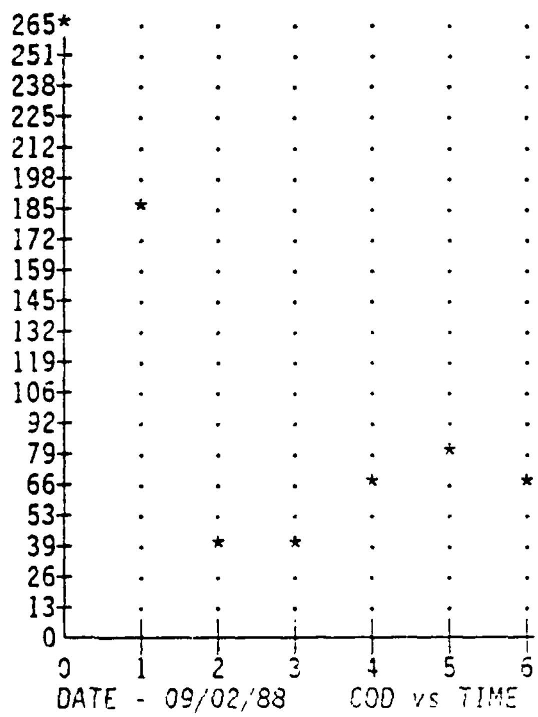
0-	15
1-	34
2-	45
3-	66
4-	46
5-	50
6-	82

DRY
WEIGHT
0.0991

PHENOL
09/02/88
ATP - 83 E-8

FREDRICK GUMM CHEM.
CLEPO ELECTROSTRIP B/C
PART C
METALLINE CHEM CORP.
K 72 (SN)

OMI INT'L CORP.
UDYSTRIP 460
PART 460 (50% ED)
OMI INT'L CORP.
UDYSTRIP XPS-306
PART 307A
WITCO CORP.
ARP-66
PART 66-B



0-	265
1-	184
2-	41
3-	44
4-	63
5-	82
6-	63

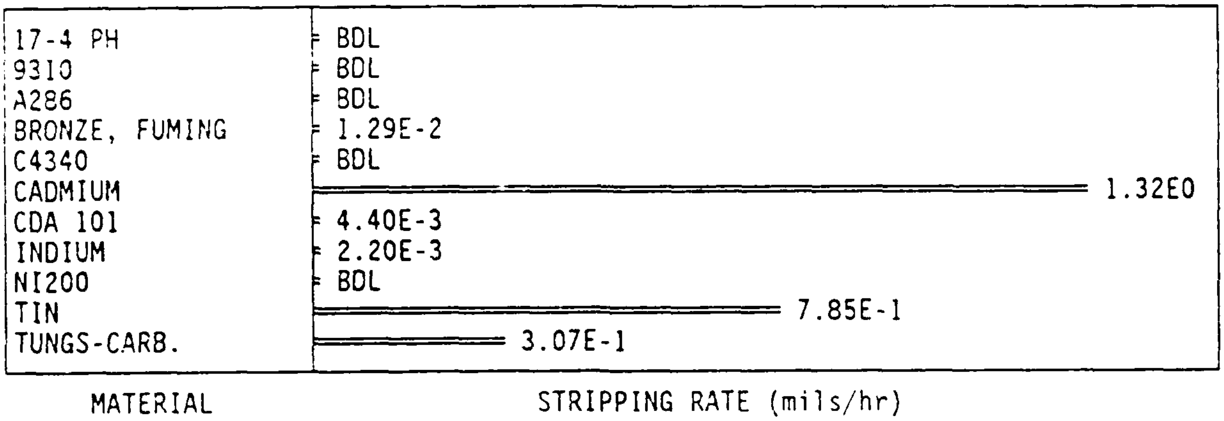
DRY
WEIGHT
0.0991

KIESOW INT'L CORP. NICKEL STRIPPER ST

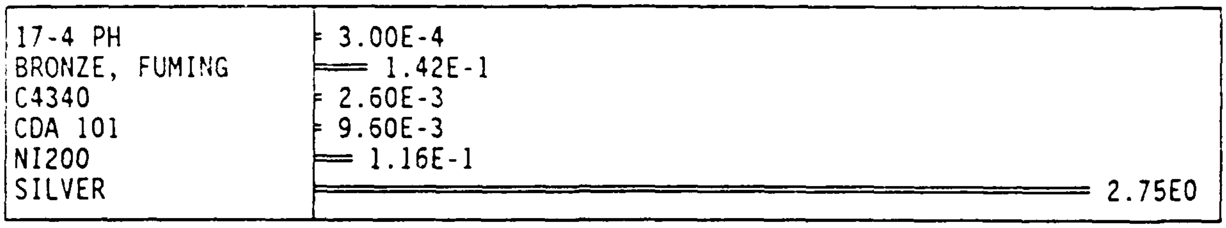
MATERIAL	STRIPPING RATE (mils/hr)
17-4 PH	BDL
316 SS	BDL
8740	5.20E-3
8740	6.60E-3
9310	1.70E-3
9310	5.40E-3
A286	BDL
A286	3.80E-3
A286	1.00E-3
C4340	1.20E-3
CADMIUM	3.27E-1
CADMIUM	2.36E-1
INDIUM	7.54E0
LEAD	BDL
LEAD	5.85E-1
LEAD	9.58E0
NI200	BDL
NI200	2.20E-3
NI200	5.34E-2

MATERIAL	STRIPPING RATE (mils/hr)
SILVER	3.41E1

MACDERMID INC. METEX NICKEL STRIPPER SCB

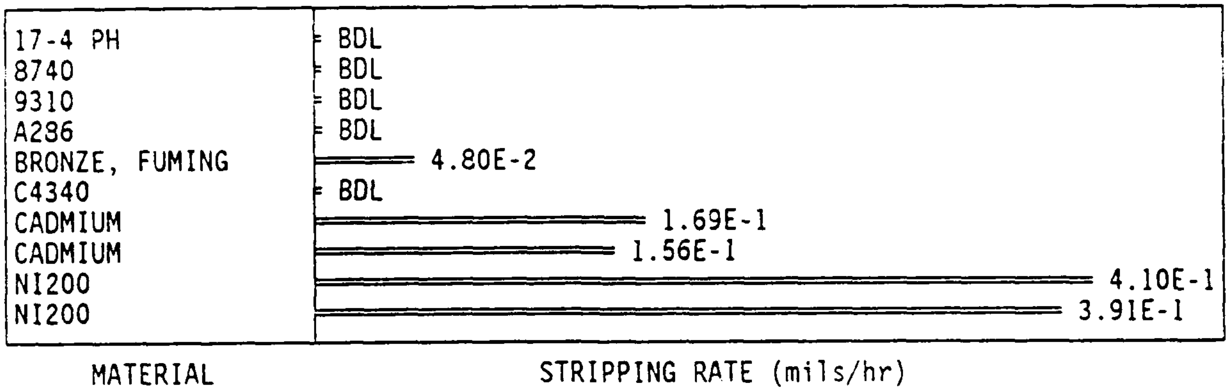


MACDERMID INC. METEX SILVER STRIPPER CB

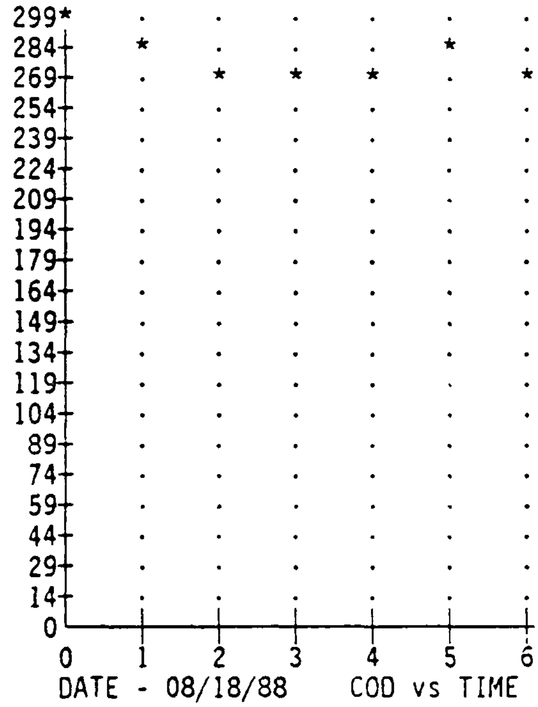


MATERIAL STRIPPING RATE (mils/hr)

METALLINE CHEM CORP. 6400 (NI)



METALLINE CHEM CORP.
6400 (NI)



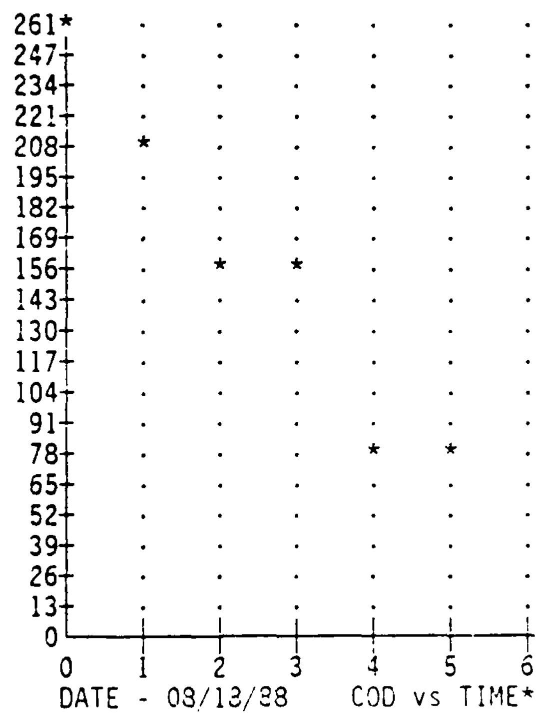
0- 299
1- 277
2- 274
3- 270
4- 276
5- 280
6- 276

DRY
WEIGHT
0.0504

PHENOL
08/18/88
ATP - 167 E-8

FREDRICK GUMM CHEM.
CLEPO 204 (IMMERSION)
PART N
FREDRICK GUMM CHEM.
CLEPO 204 (IMMERSION)
PART T
METALLINE CHEM CORP.
6400 (NI)

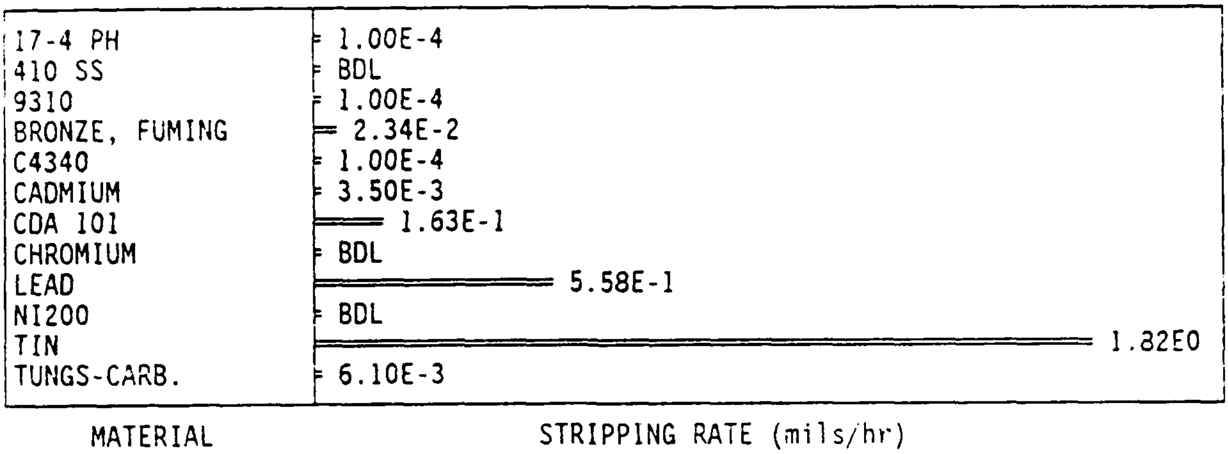
OMI INT'L CORP.
UDYSTRIP XPS-306
PART 306B



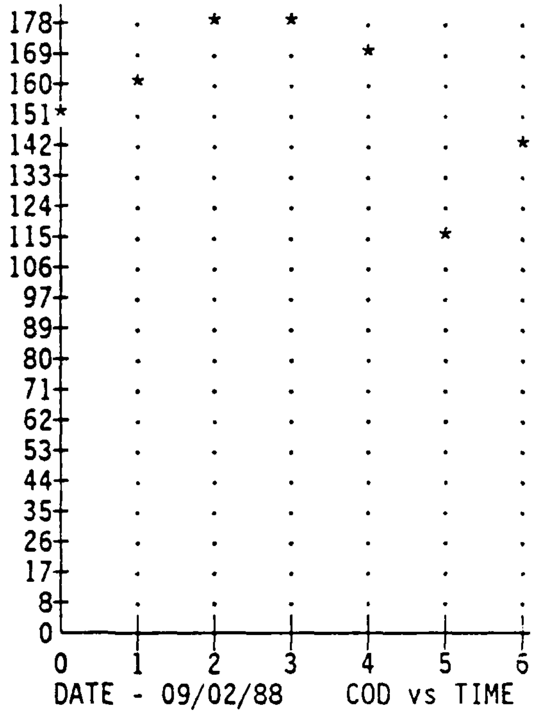
0- 261
1- 211
2- 159
3- 154
4- 80
5- 72
6- -25

DRY
WEIGHT
0.0504

METALLINE CHEM CORP. STRIPPER 672



METALLINE CHEM CORP.
672 (SN)



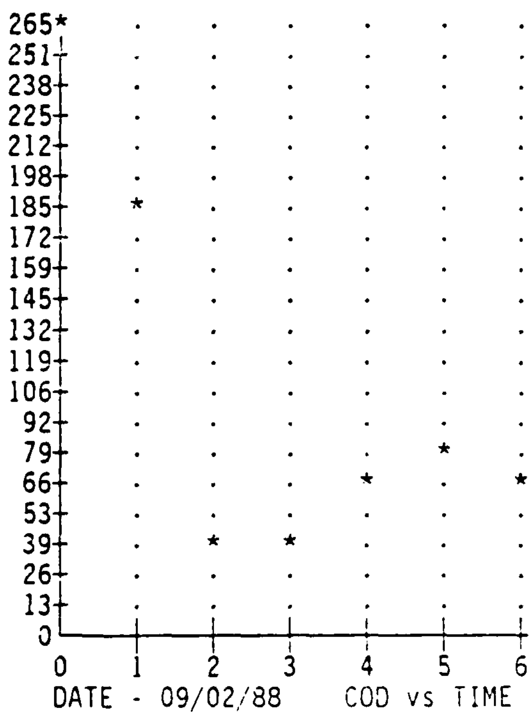
0- 148
1- 158
2- 178
3- 178
4- 172
5- 116
6- 143

DRY
WEIGHT
0.0991

PHENOL
09/02/88
ATP - 83 E-8

FREDRICK GUMM CHEM.
CLEPO ELECTROSTRIP B/C
PART C
METALLINE CHEM CORP.
672 (SN)

OMI INT'L CORP.
UDYSTRIP 460
PART 60 (50% ED)
OMI INT'L CORP.
UDYSTRIP XPS-306
PART 307A
WITCO CORP.
ARP-66
PART 66-B



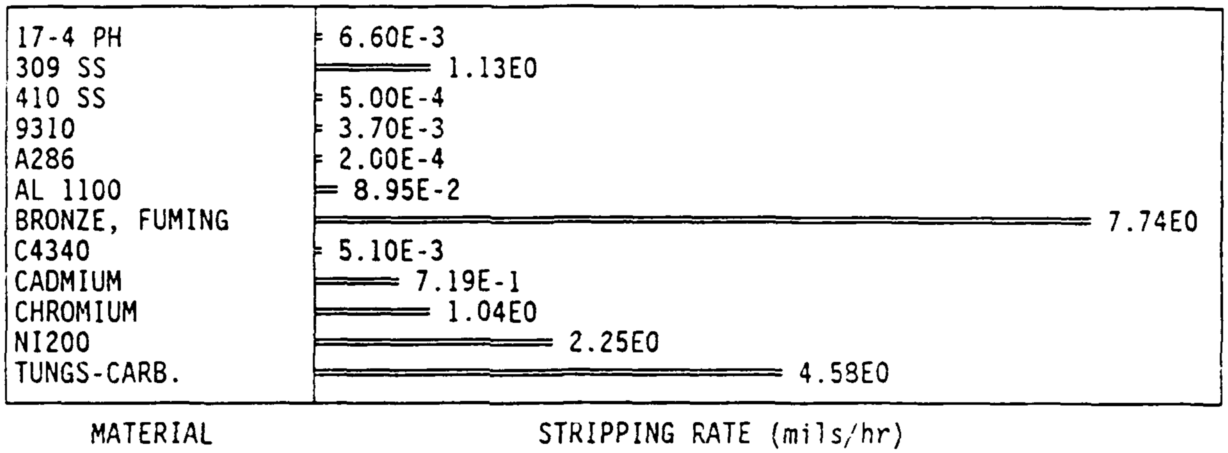
0- 265
1- 184
2- 41
3- 44
4- 63
5- 82
6- 63

DRY
WEIGHT
0.0991

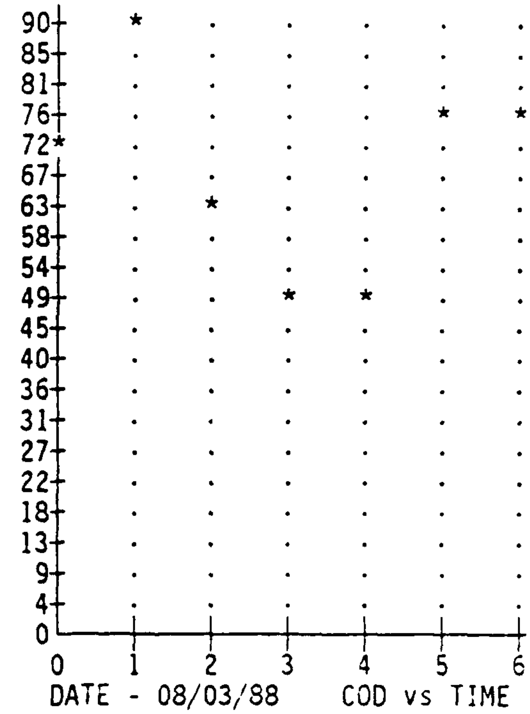
METALLINE CHEM CORP.   ZINC STRIPPER

MATERIAL	STRIPPING RATE (mils/hr)
17-4 PH	BDL
410 SS	BDL
9310	BDL
BRONZE, FUMING	5.00E-4
C4340	BDL
CADMIUM	BDL
CDA 101	6.00E-4
CHROMIUM	BDL
INCONEL 625	7.00E-4
NI200	BDL
TIN	1.90E-2
TUNGS-CARB.	4.40E-3

OMI INT'L CORP. OXYSTRIP 600C



OMI INT'L CORP.
OXYSTRIP 6000



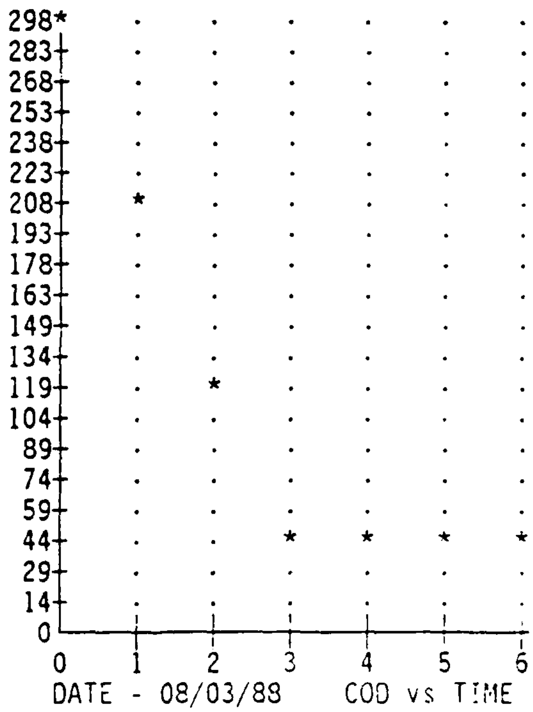
0- 74
1- 90
2- 62
3- 50
4- 49
5- 75
6- 76

DRY
WEIGHT
0.0854

PHENOL
08/03/88
ATP - 6 E-8

OMI INT'L CORP.
OXYSTRIP 6000

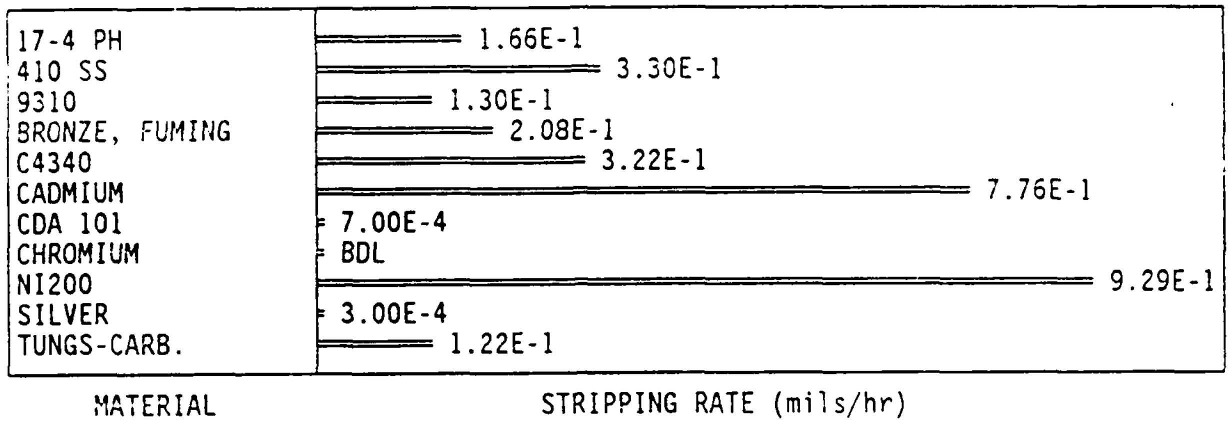
OMI INT'L CORP.
UDYSTRIP 406
PART 406
PATCLIN
DIP N STRIP III
PART DIP N
PATCLIN
PATSTRIP NI-E

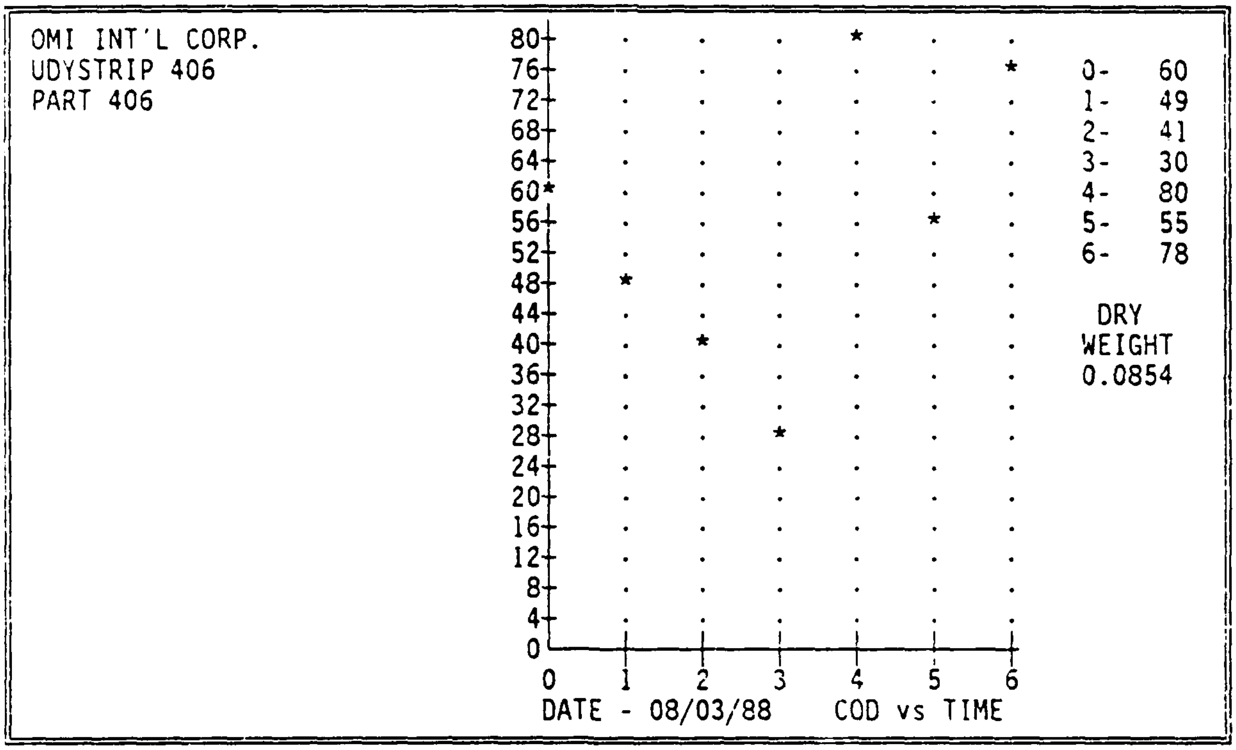


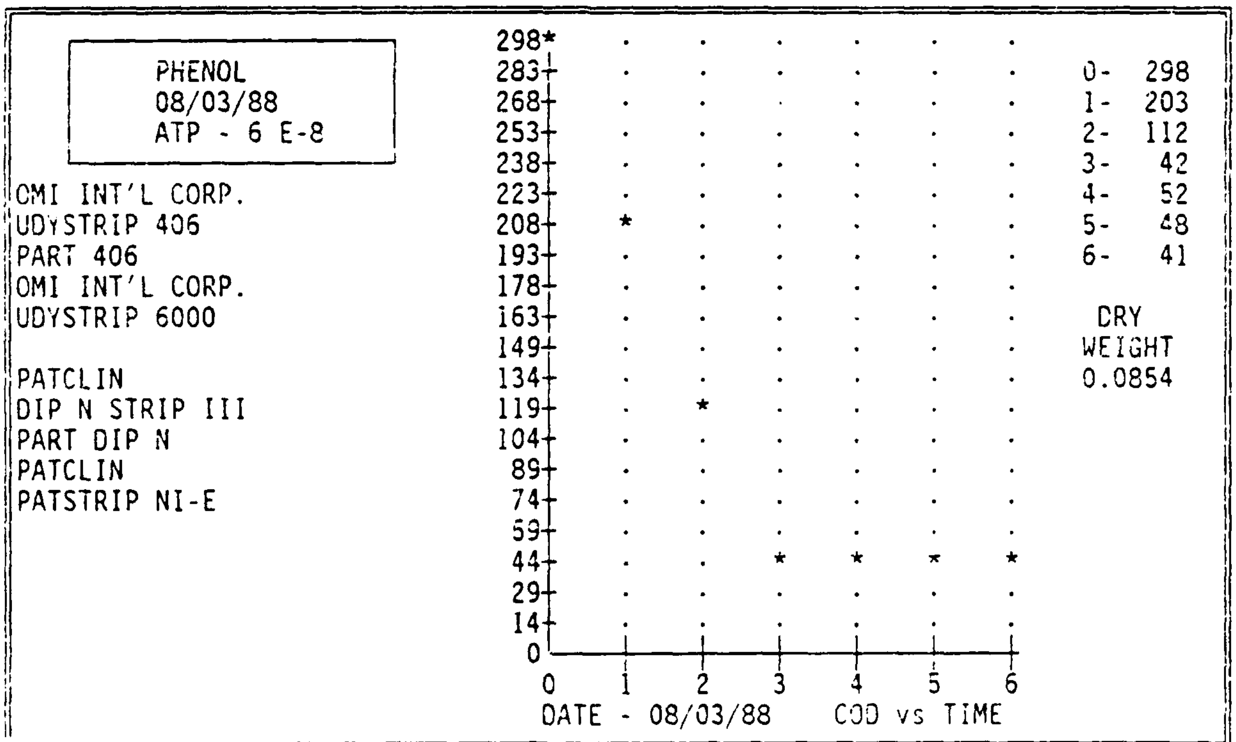
0- 298
1- 203
2- 112
3- 42
4- 52
5- 48
6- 41

DRY
WEIGHT
0.0854

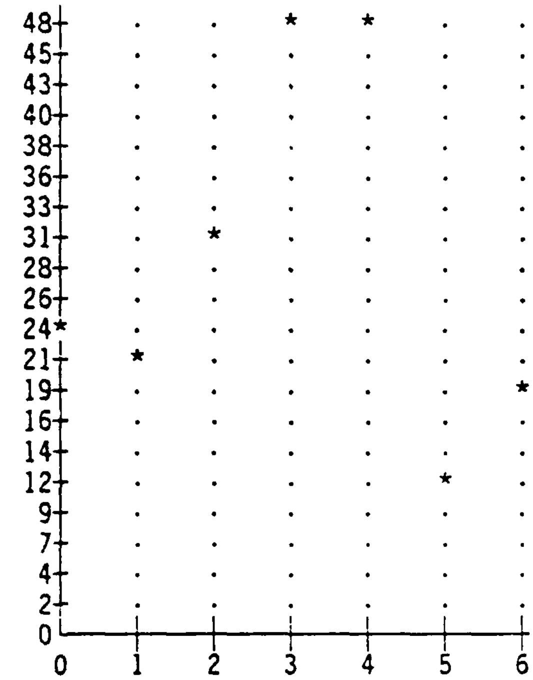
OMI INT'L CORP. UDYSTRIP 406




OMI INT'L CORP.
UDYSTRIP 406
PART 406
0- 60
1- 49
2- 41
3- 30
4- 80
5- 55
6- 78
DRY WEIGHT 0.0854
DATE - 08/03/88 COD vs TIME


PHENOL
08/03/88
ATP - 6 E-8
OMI INT'L CORP.
UDYSTRIP 406
PART 406
OMI INT'L CORP.
UDYSTRIP 6000
PATCLIN
DIP N STRIP III
PART DIP N
PATCLIN
PATSTRIP NI-E
0- 298
1- 203
2- 112
3- 42
4- 52
5- 48
6- 41
DRY WEIGHT 0.0854
DATE - 08/03/88 COD vs TIME

OMI INT'L CORP.
UDYSTRIP 406
PART 406

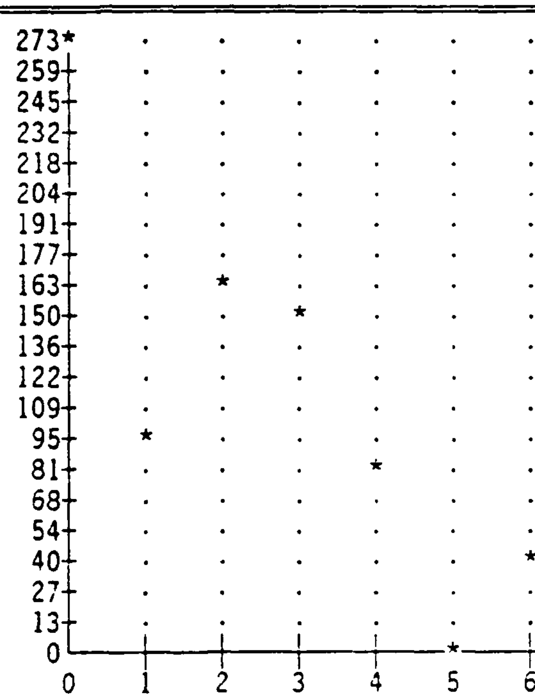


0-	24
1-	22
2-	32
3-	48
4-	48
5-	12
6-	20

DRY
WEIGHT
0.0811

PHENOL
08/31/88
ATP - 297 E-8

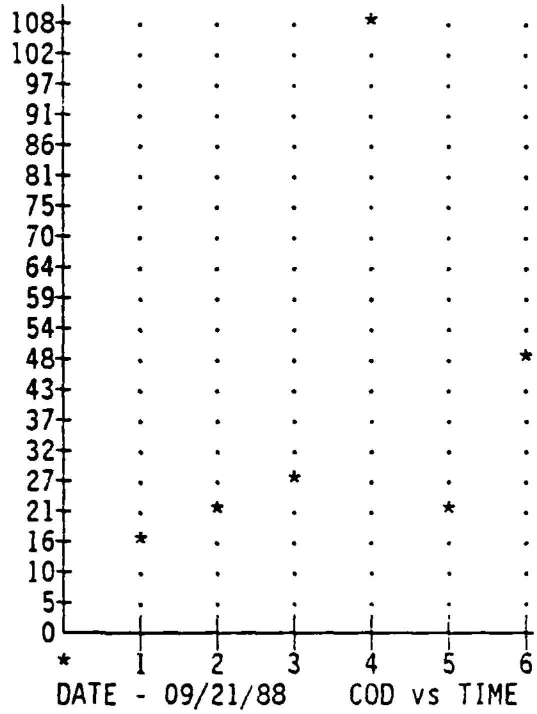
CIRCUIT CHEM. CORP.
CIRSTRIP NCN-CU A,B
PART A
CIRCUIT CHEM. CORP.
CIRSTRIP NCN-CU A,B
PART A
CIRCUIT CHEM. CORP.
CIRSTRIP NCN-CU A,B
PART B
ELECTROCHEMICALS
NICKEL-SOL
CPX-II
ELECTROCHEMICALS
NICKEL-SOL
NICKEL-SOL I
OMI INT'L CORP.
UDYSTRIP 406
PART 406



0-	273
1-	96
2-	170
3-	144
4-	81
5-	0
6-	37

DRY
WEIGHT
0.0811

OMI INT'L CORP.
UDYSTRIP 406
PART 406

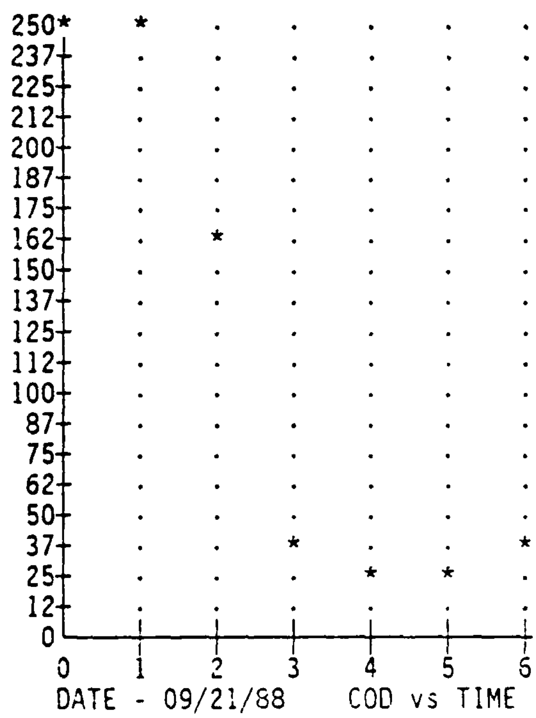


0- -16
1- 16
2- 22
3- 26
4- 108
5- 23
6- 46

DRY
WEIGHT
0.0838

PHENOL
09/21/88
ATP - 142 E-8

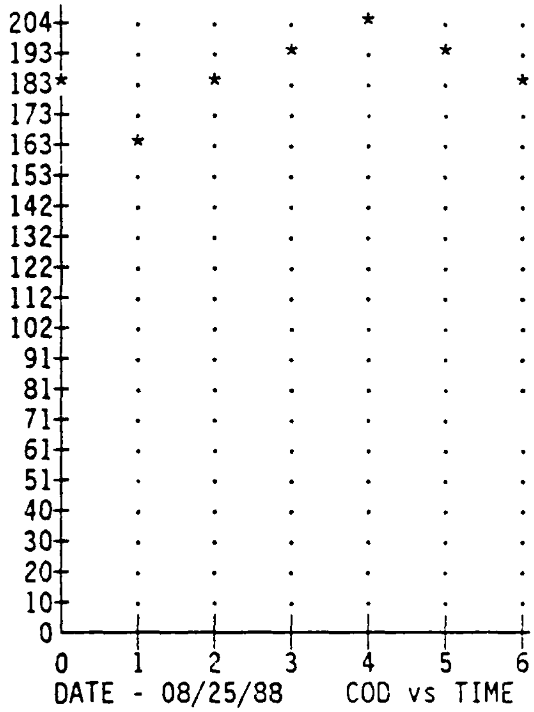
ELECTROCHEMICALS
NICKEL-SOL
CPX-II
OMI INT'L CORP.
UDYSTRIP 406
PART 406
OMI INT'L CORP.
UDYSTRIP 406
PART 408



0- 246
1- 250
2- 164
3- 34
4- 24
5- 22
6- 38

DRY
WEIGHT
0.0838

OMI INT'L CORP.
UDYSTRIP 406
PART 408

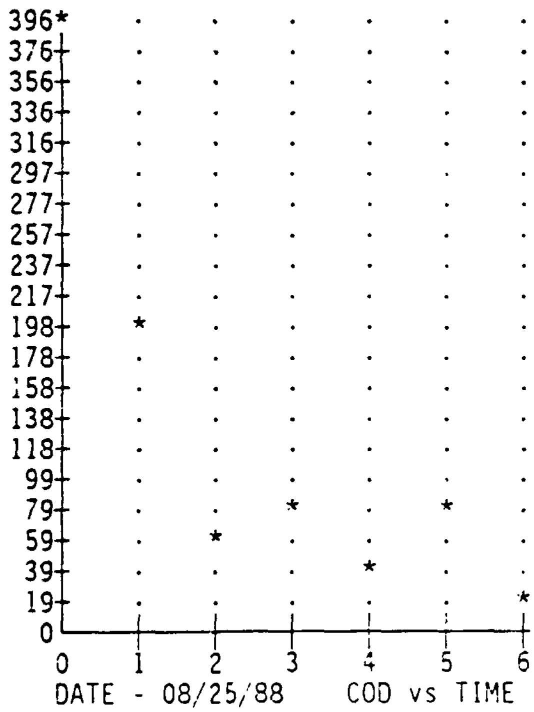


0- 179
1- 168
2- 183
3- 197
4- 204
5- 194
6- 188

DRY
WEIGHT
0.0887

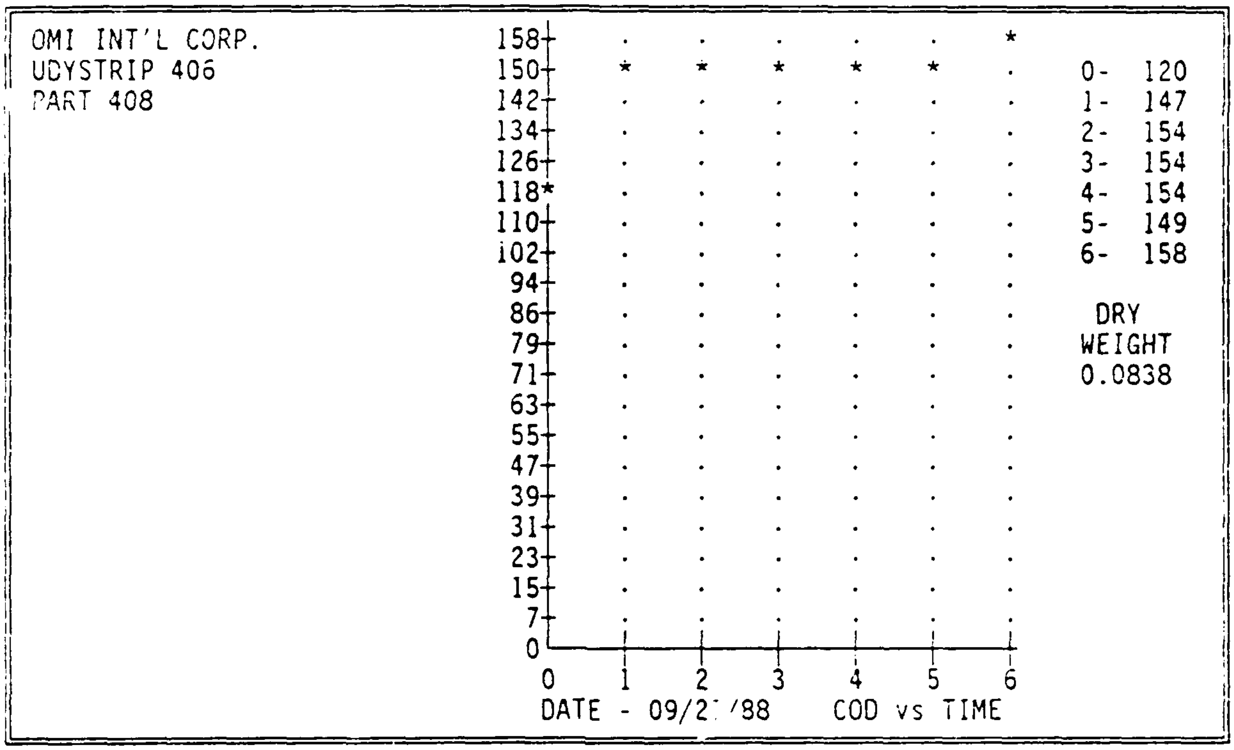
PHENOL
08/25/88
ATP - 43 E-8

CIRCUIT CHEM. CORP.
NICSTRIP NCN-SCB
PART 1
CIRCUIT CHEM. CORP.
NICSTRIP NCN-SCB
PART 2
ELECTROCHEMICALS
NICKEL-SOL
CPX-II
OMI INT'L CORP.
UDYSTRIP 406
PART 408

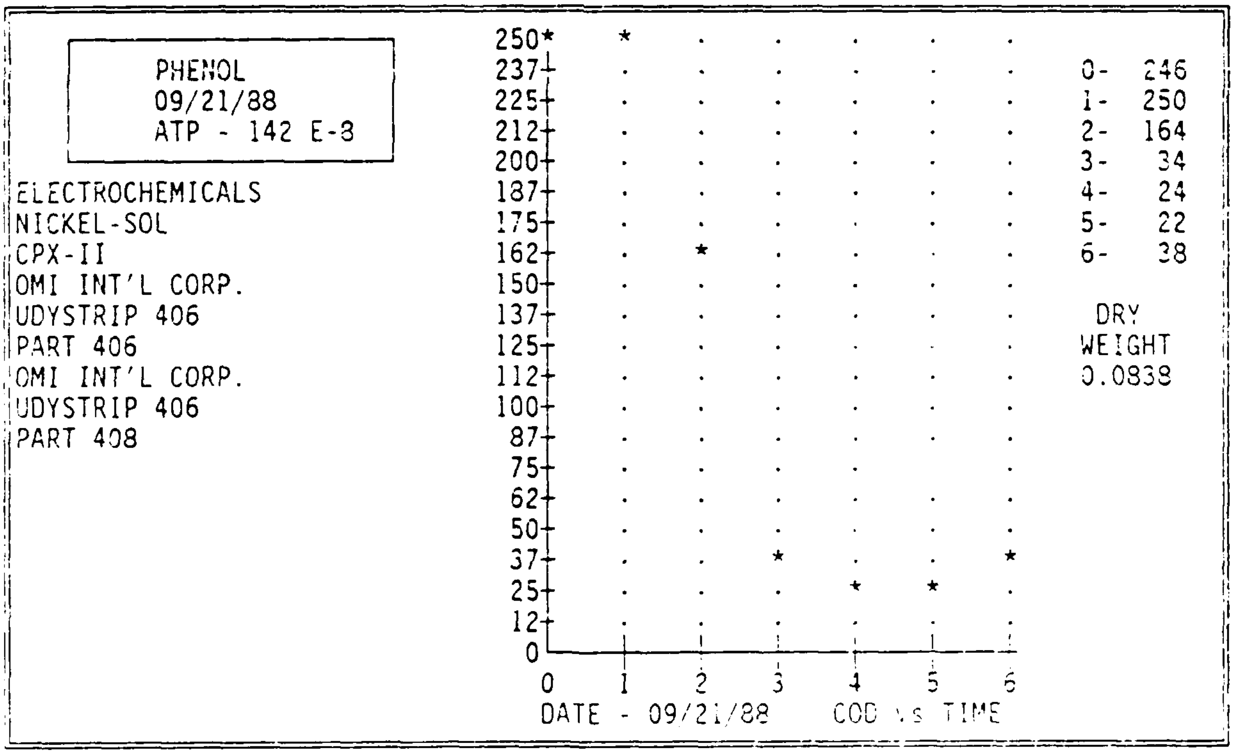


0- 396
1- 196
2- 50
3- 78
4- 47
5- 74
6- 11

DRY
WEIGHT
0.0887



OMI INT'L CORP.
UDYSTRIP 406
PART 408
158 150 142 134 126 118 110 102 94 86 79 71 63 55 47 39 31 23 15 7 0
0 1 2 3 4 5 6
DATE - 09/2 /88
COD vs TIME
0- 120
1- 147
2- 154
3- 154
4- 154
5- 149
6- 158
DRY
WEIGHT
0.0838

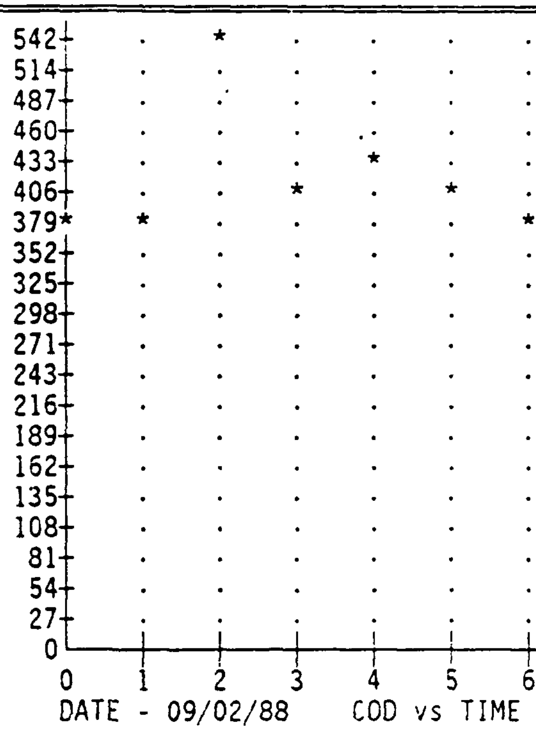


PHENOL
09/21/88
ATP - 142 E-8
ELECTROCHEMICALS
NICKEL-SOL
CPX-II
OMI INT'L CORP.
UDYSTRIP 406
PART 406
OMI INT'L CORP.
UDYSTRIP 406
PART 408
250 237 225 212 200 187 175 162 150 137 125 112 100 87 75 62 50 37 25 12 0
0 1 2 3 4 5 6
DATE - 09/21/88
COD vs TIME
0- 246
1- 250
2- 164
3- 34
4- 24
5- 22
6- 38
DRY
WEIGHT
0.0838

OMI INT'L CORP. UDYSTRIP 460

MATERIAL	STRIPPING RATE (mils/hr)
17-4 PH	1.00E-4
309 SS	BDL
8740	BDL
9310	BDL
A286	BDL
BRONZE, FUMING	1.80E-3
C4340	1.00E-4
CADMIUM	1.74E0
CDA 101	9.43E-2
NI200	2.00E-4
TIN	6.68E-2
TUNGS-CARB.	2.65E-2

OMI INT'L CORP.
UDYSTRIP 460
PART 460 (50% ED)



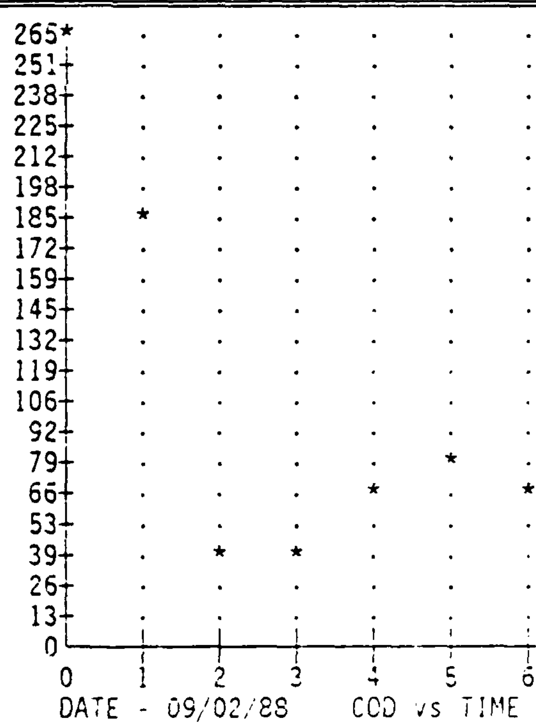
0- 378
1- 384
2- 542
3- 420
4- 433
5- 404
6- 371

DRY
WEIGHT
0.0991

PHENOL
09/02/88
ATP - 83 E-8

FREDRICK GUMM CHEM.
CLEPO ELECTROSTRIP B/C
PART C
METALLINE CHEM CORP.
K 72 (SN)

OMI INT'L CORP.
UDYSTRIP 460
PART 460 (50% ED)
OMI INT'L CORP.
UDYSTRIP XPS-306
PART 307A
WITCO CORP.
ARP-66
PART 56-B



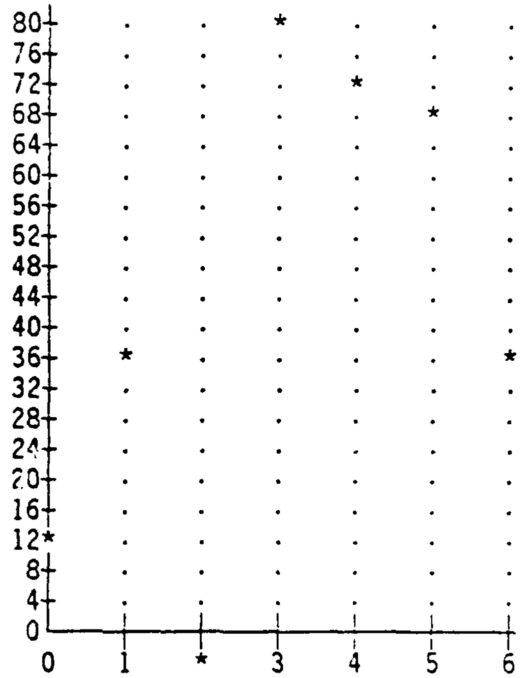
0- 265
1- 184
2- 41
3- 44
4- 63
5- 82
6- 63

DRY
WEIGHT
0.0991

OMI INT'L CORP. UDYSTRIP 7000

MATERIAL	STRIPPING RATE (mils/hr)
17-4 PH	2.00E-4
309 SS	1.20E-3
410 SS	3.00E-4
8740	2.90E-3
9310	2.50E-3
BRONZE, FUMING	2.12E-1
C4340	8.00E-3
CADMIUM	7.19E0
CDA 101	6.77E-1
NI200	8.00E-2
TUNGS-CARB.	7.09E0

OMI INT'L CORP.
UDYSTRIP 7000



DATE - 09/22/88 COD vs TIME

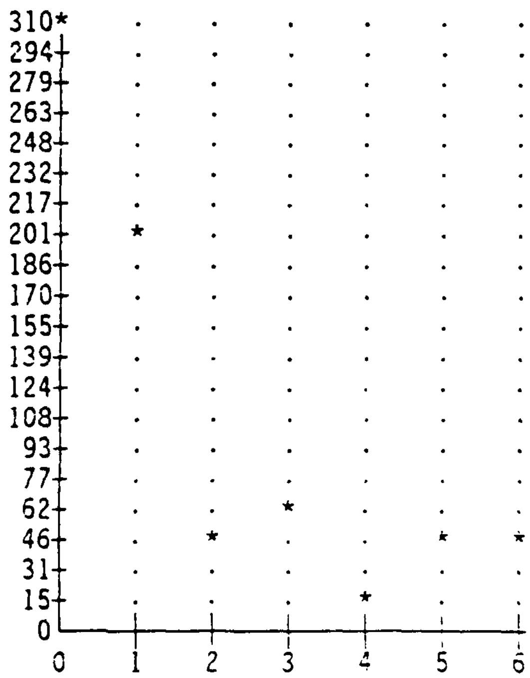
0-	14
1-	36
2-	-16
3-	80
4-	74
5-	68
6-	38

DRY
WEIGHT
0.0770

PHENOL
09/22/88
ATP - 81 E-8

OMI INT'L CORP.
UDYSTRIP 7000

PATCLIN
PATSTRIP NIX-85
PART 72Y
WITCO CORP.
ARP-66
PART 66-A

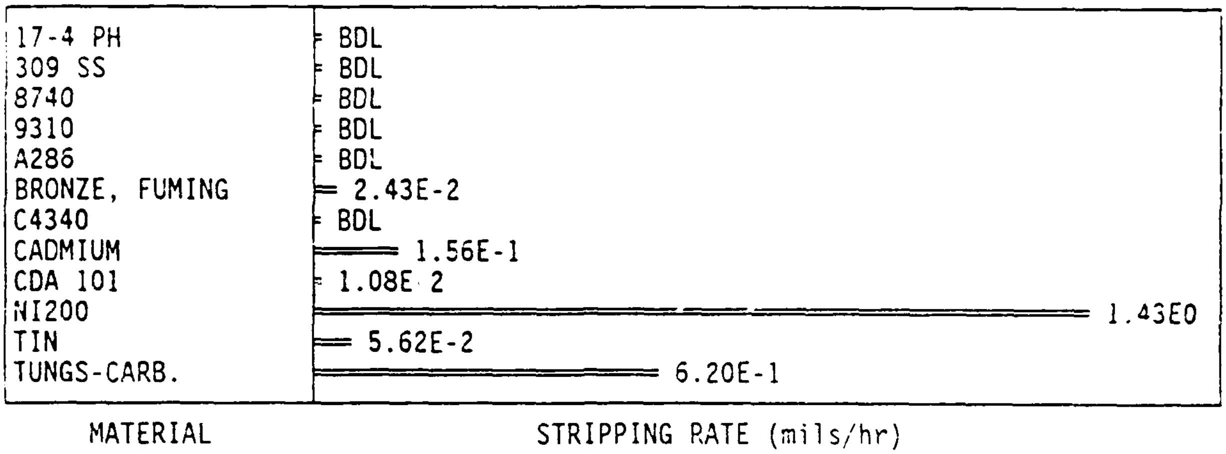


DATE - 09/22/88 COD vs TIME

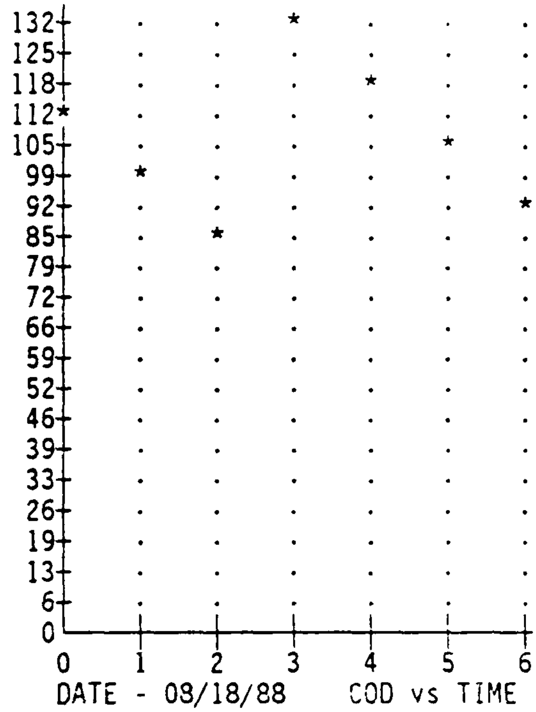
0-	310
1-	198
2-	41
3-	61
4-	22
5-	44
6-	40

DRY
WEIGHT
0.0770

OMI INT'L CORP. UDYSTRIP XPS-306



OMI INT'L CORP.
UDYSTRIP XPS-306
PART 306B



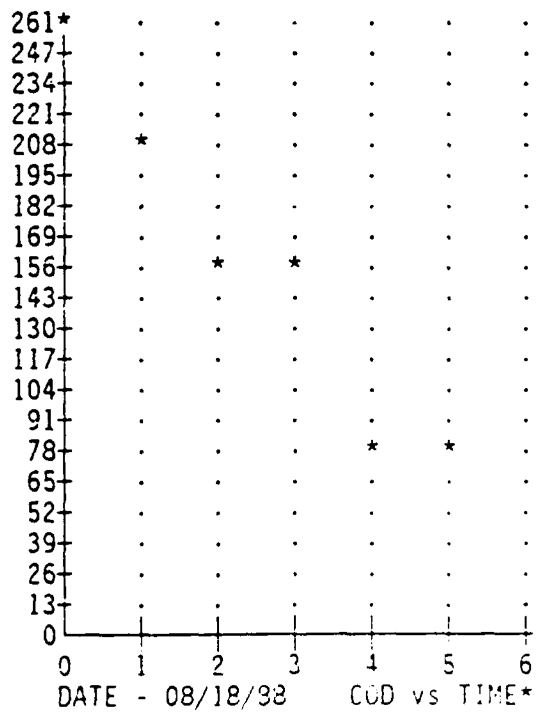
0- 113
1- 96
2- 88
3- 132
4- 117
5- 108
6- 94

DRY
WEIGHT
0.0504

PHENOL
08/18/88
ATP - 167 E-8

FREDRICK GUMM CHEM.
CLEPO 204 (IMMERSION)
PART N
FREDRICK GUMM CHEM.
CLEPO 204 (IMMERSION)
PART T
METALLINE CHEM CORP.
6400 (NI)

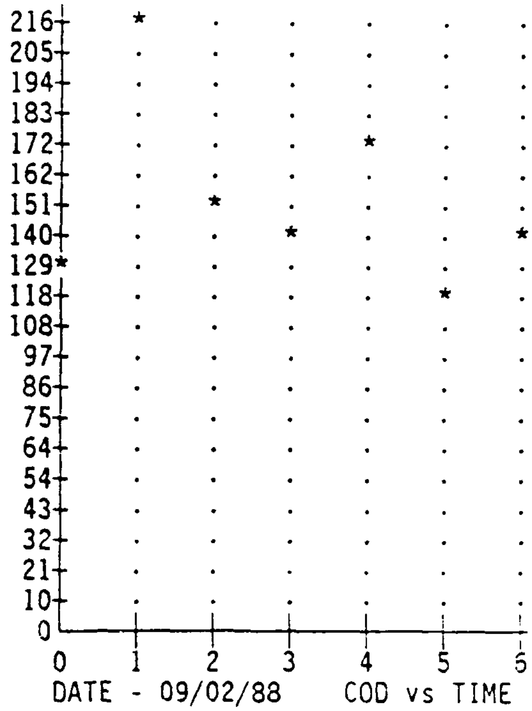
OMI INT'L CORP.
UDYSTRIP XPS-306
PART 306B



0- 261
1- 211
2- 159
3- 154
4- 80
5- 72
6- -25

DRY
WEIGHT
0.0504

OMI INT'L CORP.
UDYSTRIP XPS-306
PART 307A



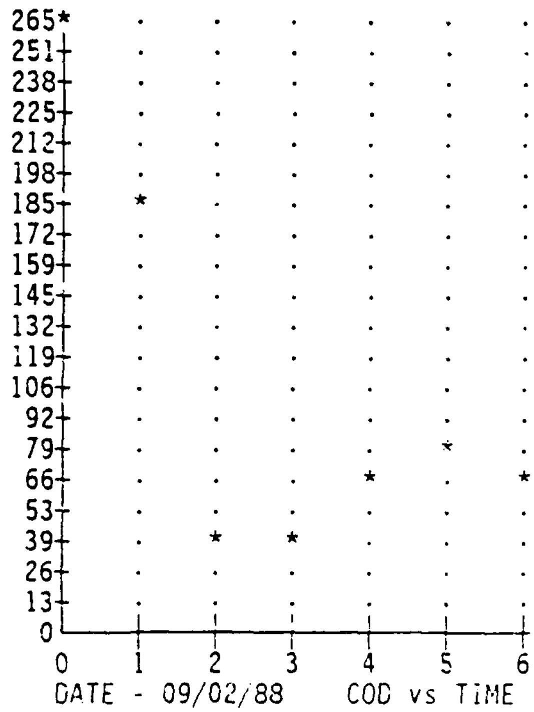
0- 132
1- 216
2- 156
3- 136
4- 172
5- 124
6- 140

DRY
WEIGHT
0.0991

PHENOL
09/02/88
ATP - 83 E-8

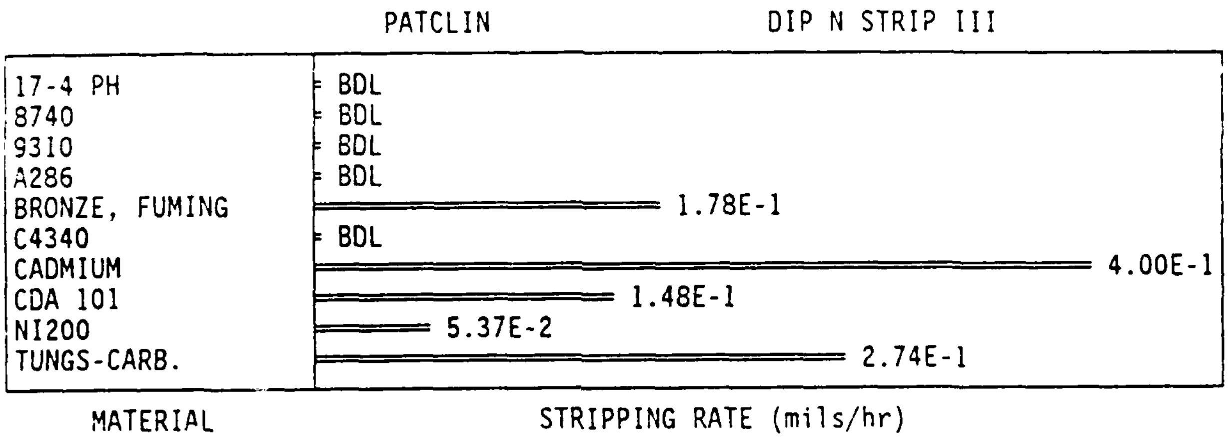
FREDRICK GUMM CHEM.
CLEPO ELECTROSTRIP B/C
PART C
METALLINE CHEM CORP.
K 72 (SN)

OMI INT'L CORP.
UDYSTRIP 460
PART 460 (50% ED)
OMI INT'L CORP.
UDYSTRIP XPS-306
PART 307A
WITCO CORP.
ARP-66
PART 66-B

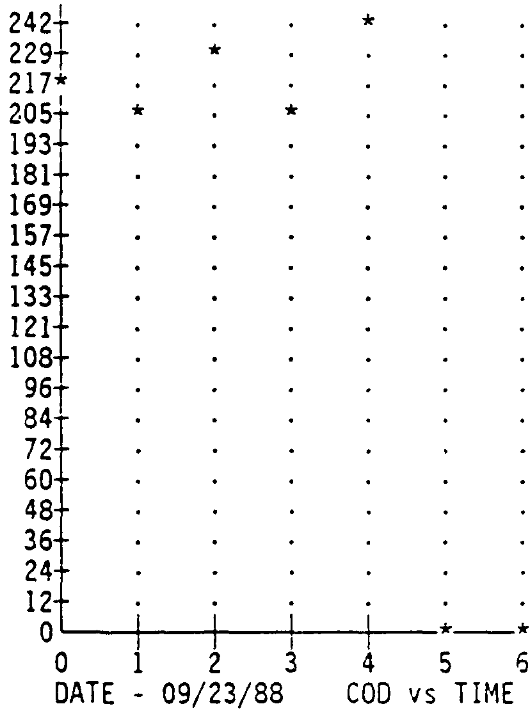


0- 265
1- 184
2- 41
3- 44
4- 63
5- 82
6- 63

DRY
WEIGHT
0.0991


PATCLIN
DIP N STRIP III
17-4 PH
8740
9310
A286
BRONZE, FUMING
C4340
CADMIUM
CDA 101
NI200
TUNGS-CARB.
BDL
BDL
BDL
BDL
1.78E-1
BDL
4.00E-1
1.48E-1
5.37E-2
2.74E-1
MATERIAL
STRIPPING RATE (mils/hr)

PATCLIN
DIP N STRIP III
Ni-2

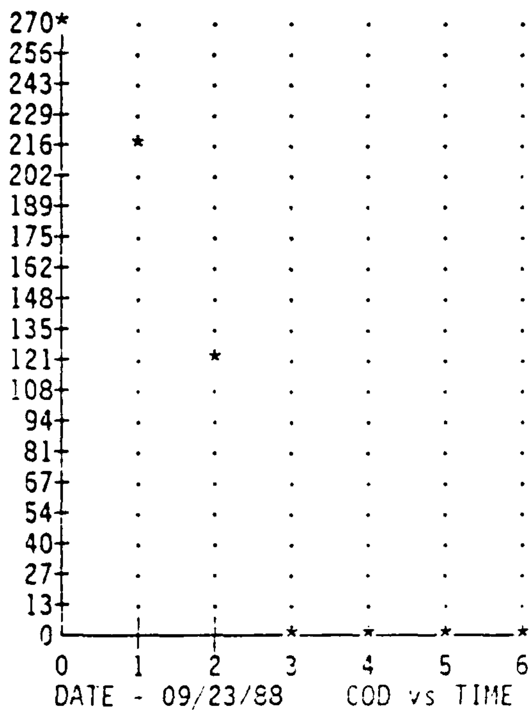


0- 217
1- 201
2- 232
3- 202
4- 242
5- 0
6- 0

DRY
WEIGHT
0.0850

PHENOL
09/23/88
ATP - 92 E-8

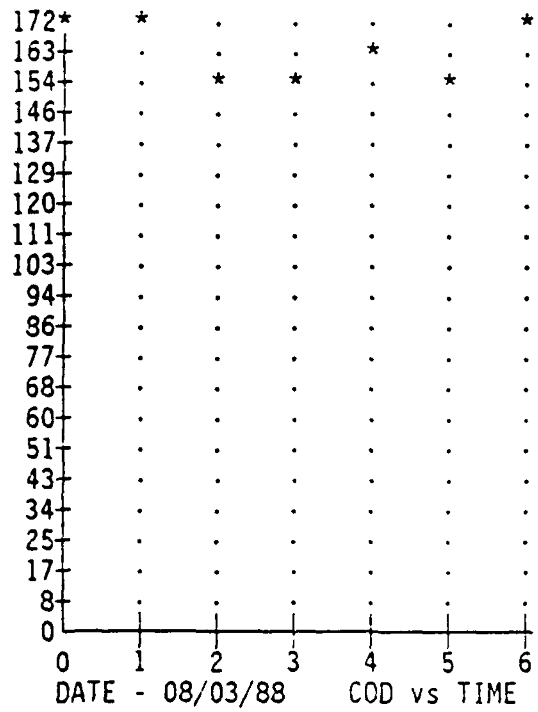
FREDRICK GUMM CHEM.
CLEPO ELECTROSTRIP B/C
PART B
FREDRICK GUMM CHEM.
CLEPO ELECTROSTRIP B/C
PART C
PATCLIN
DIP N STRIP III
Ni-2



0- 270
1- 212
2- 118
3- 2
4- 0
5- 0
6- 0

DRY
WEIGHT
0.0850

PATCLIN
DIP N STRIP III
PART DIP N



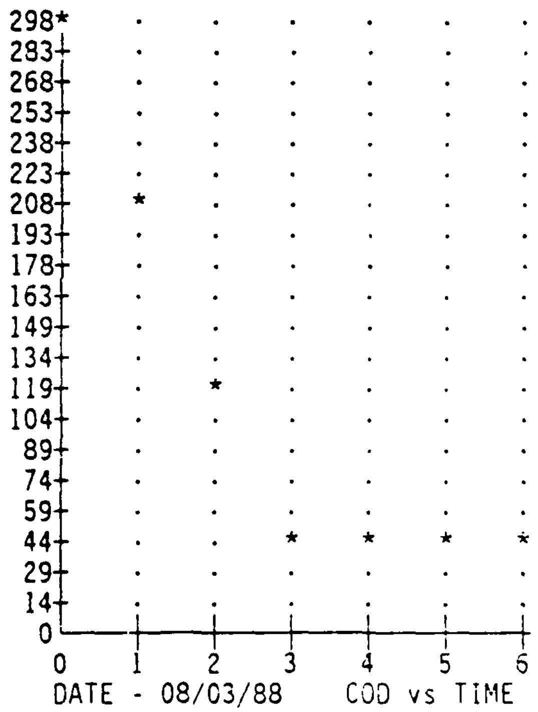
0- 172
1- 171
2- 152
3- 159
4- 166
5- 154
6- 168

DRY
WEIGHT
0.0854

PHENOL
08/03/88
ATP - 6 E-8

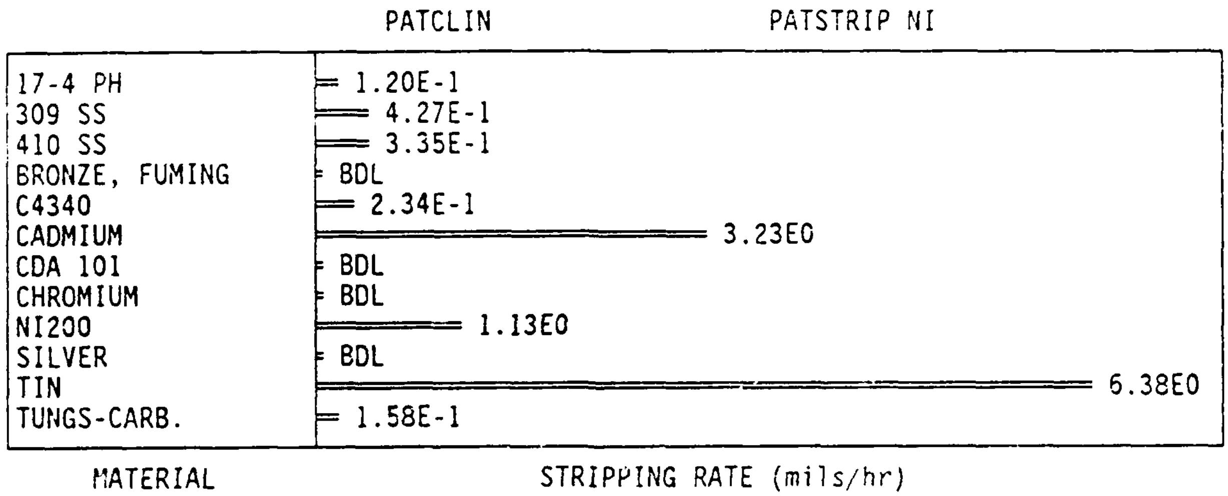
OMI INT'L CORP.
UDYSTRIP 406
PART 406
OMI INT'L CORP.
UDYSTRIP 6000

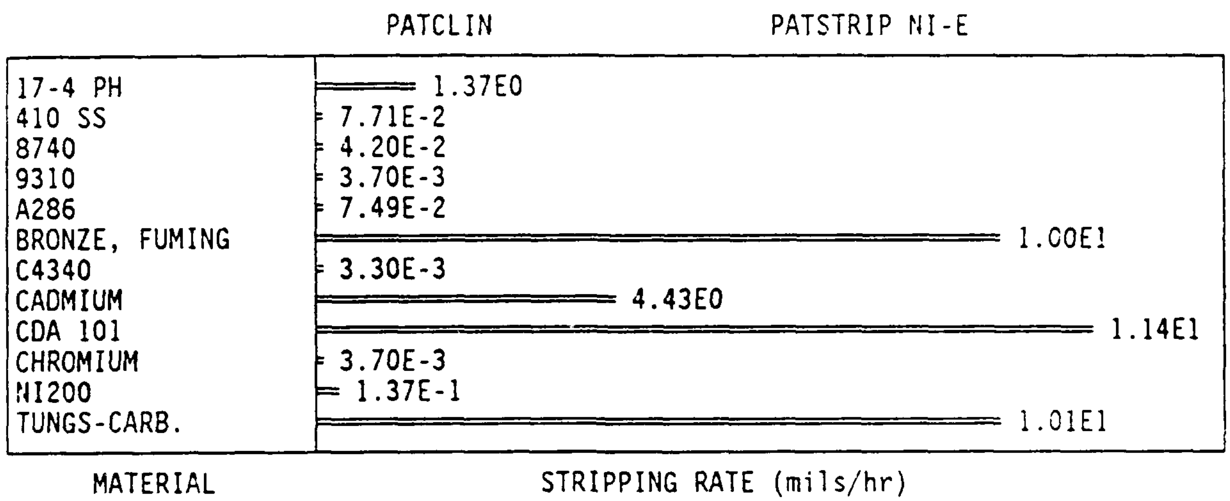
PATCLIN
DIP N STRIP III
PART DIP N
PATCLIN
PATSTRIP NI-E

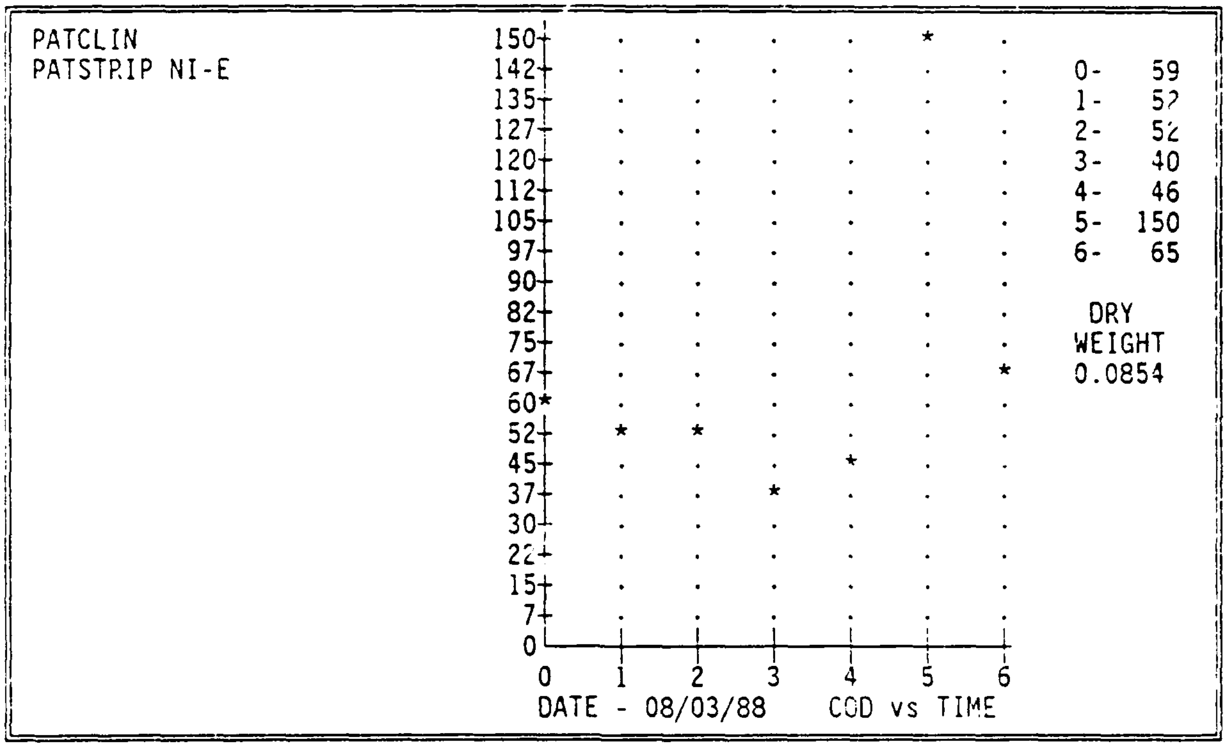


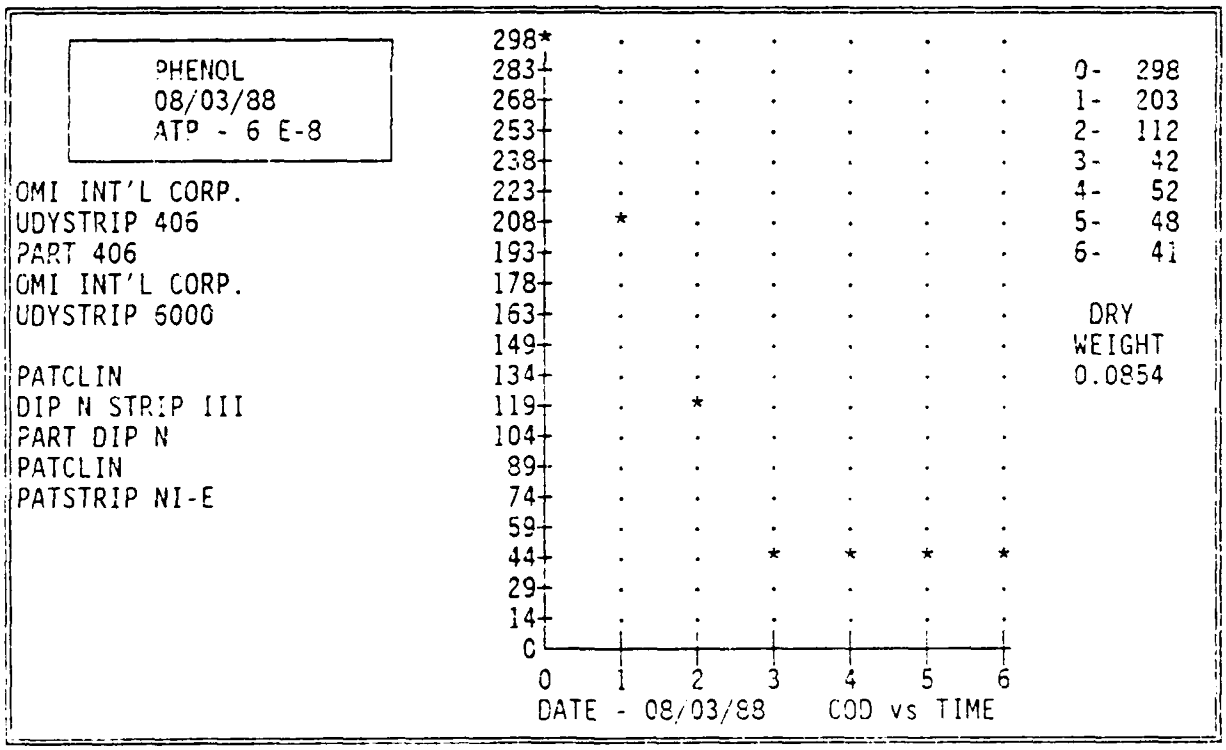
0- 298
1- 203
2- 112
3- 42
4- 52
5- 48
6- 41

DRY
WEIGHT
0.0854

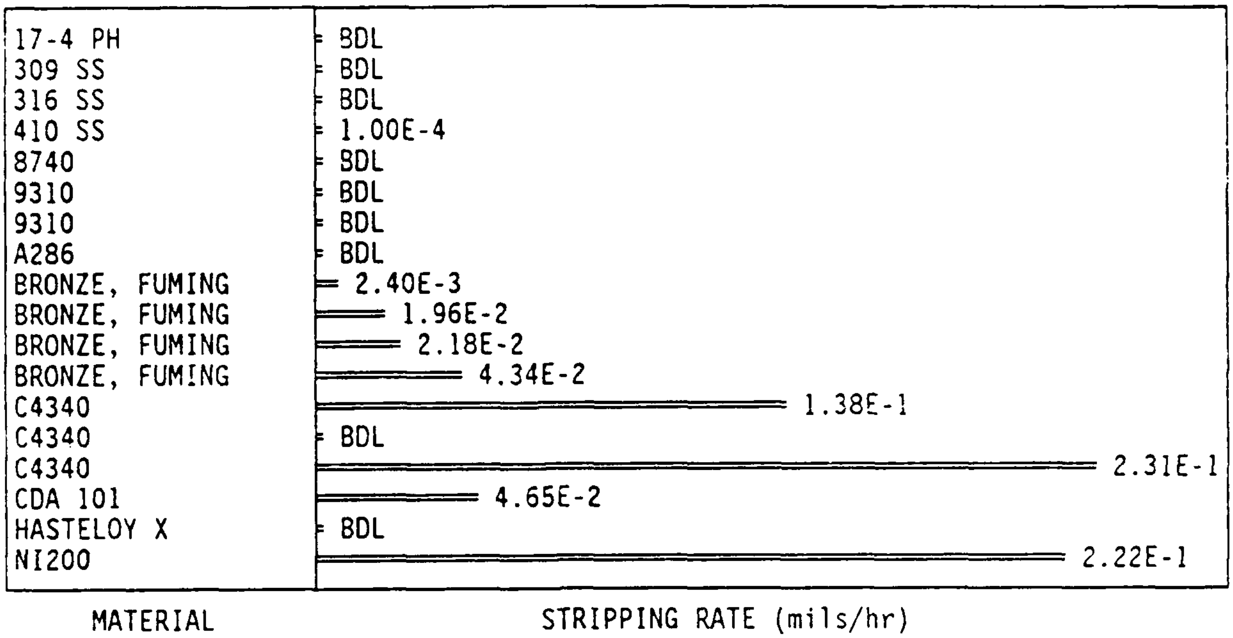

PATCLIN
PATSTRIP NI
17-4 PH
309 SS
410 SS
BRONZE, FUMING
C4340
CADMIUM
CDA 101
CHROMIUM
NI200
SILVER
TIN
TUNGS-CARB.
1.20E-1
4.27E-1
3.35E-1
BDL
2.34E-1
3.23E0
BDL
BDL
1.13E0
BDL
6.38E0
1.58E-1
MATERIAL
STRIPPING RATE (mils/hr)

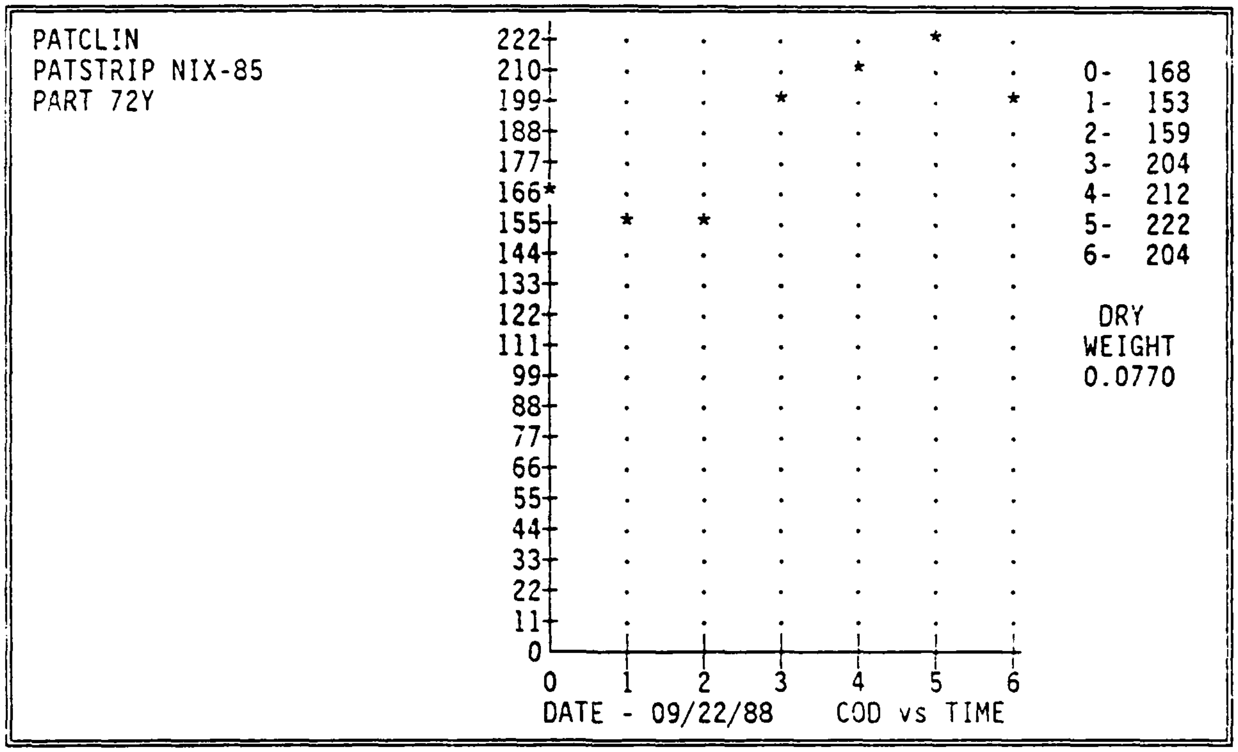

PATCLIN
PATSTRIP NI-E
17-4 PH
410 SS
8740
9310
A286
BRONZE, FUMING
C4340
CADMIUM
CDA 101
CHROMIUM
NI200
TUNGS-CARB.
1.37E0
7.71E-2
4.20E-2
3.70E-3
7.49E-2
1.00E1
3.30E-3
4.43E0
1.14E1
3.70E-3
1.37E-1
1.01E1
MATERIAL
STRIPPING RATE (mils/hr)

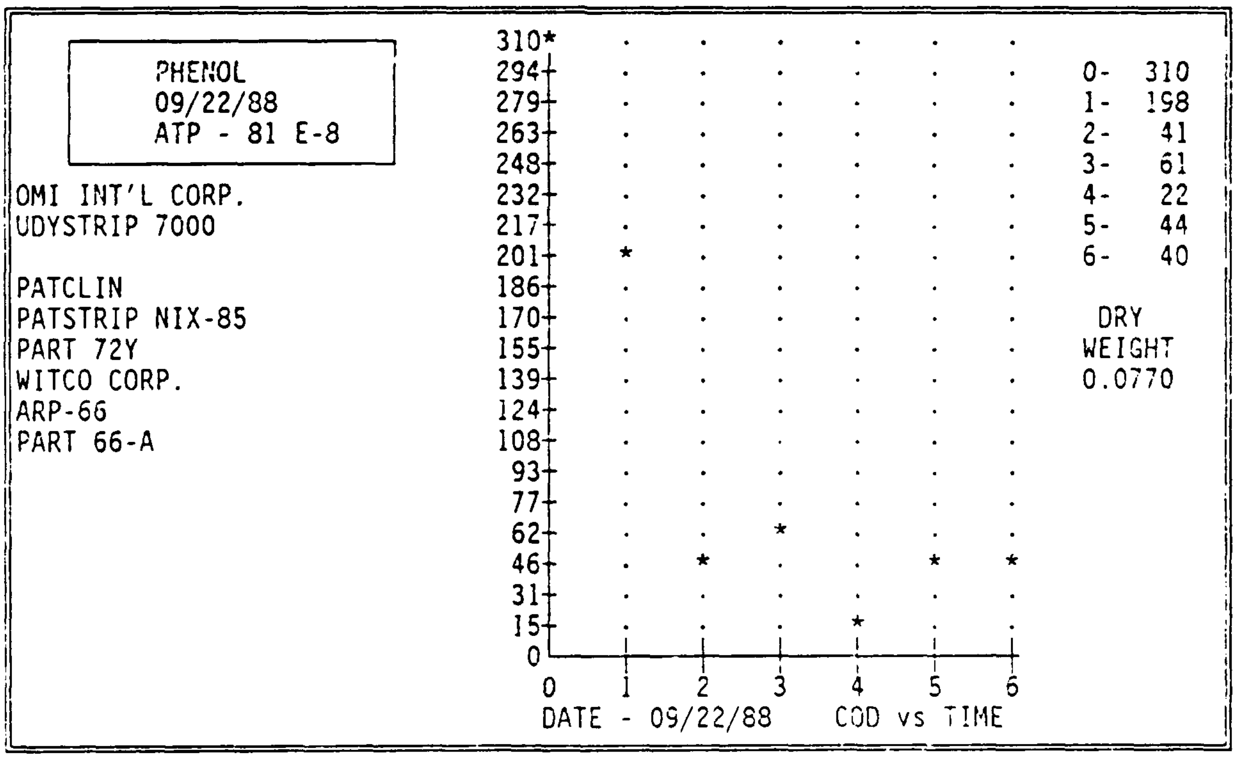

PATCLIN
PATSTRIP NI-E
150
142
135
127
120
112
105
97
90
82
75
67
60
52
45
37
30
22
15
7
0
0 1 2 3 4 5 6
DATE - 08/03/88 COD vs TIME
0- 59
1- 52
2- 52
3- 40
4- 46
5- 150
6- 65
DRY
WEIGHT
0.0854

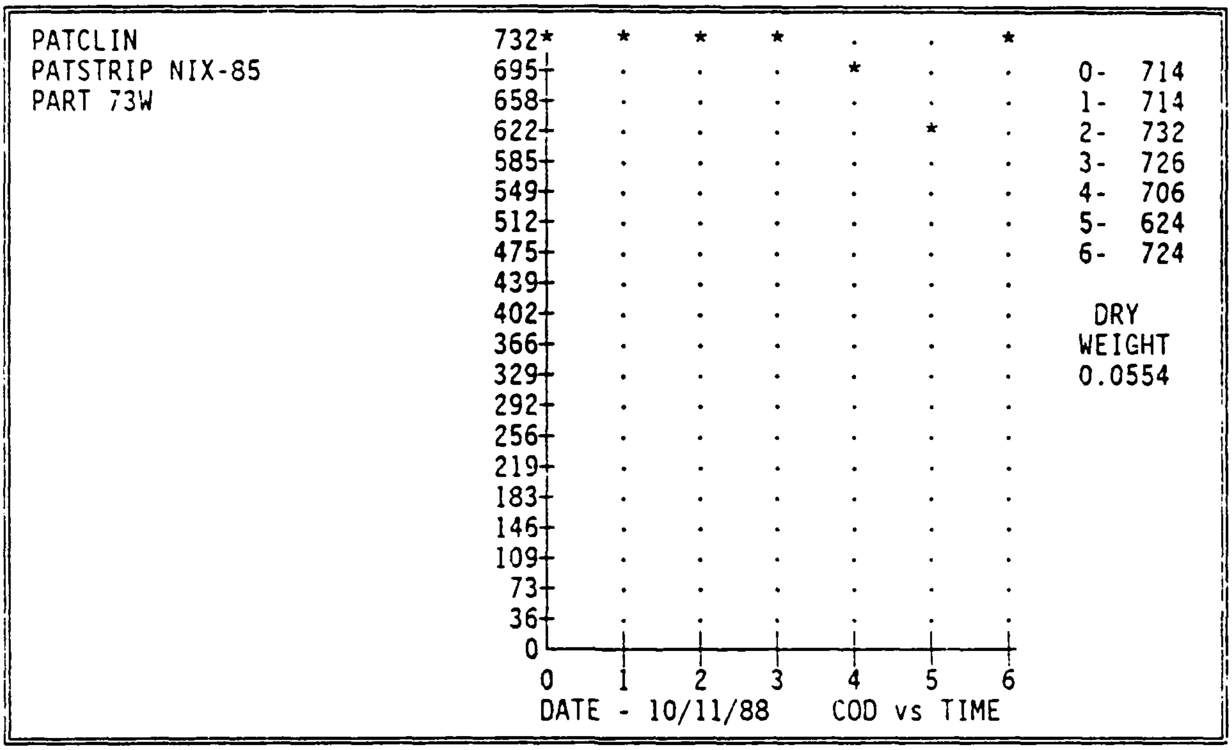

PHENOL
08/03/88
ATP - 6 E-8
OMI INT'L CORP.
UDYSTRIP 406
PART 406
OMI INT'L CORP.
UDYSTRIP 6000
PATCLIN
DIP N STRIP III
PART DIP N
PATCLIN
PATSTRIP NI-E
298
283
268
253
238
223
208
193
178
163
149
134
119
104
89
74
59
44
29
14
0
0 1 2 3 4 5 6
DATE - 08/03/88 COD vs TIME
0- 298
1- 203
2- 112
3- 42
4- 52
5- 48
6- 41
DRY
WEIGHT
0.0854

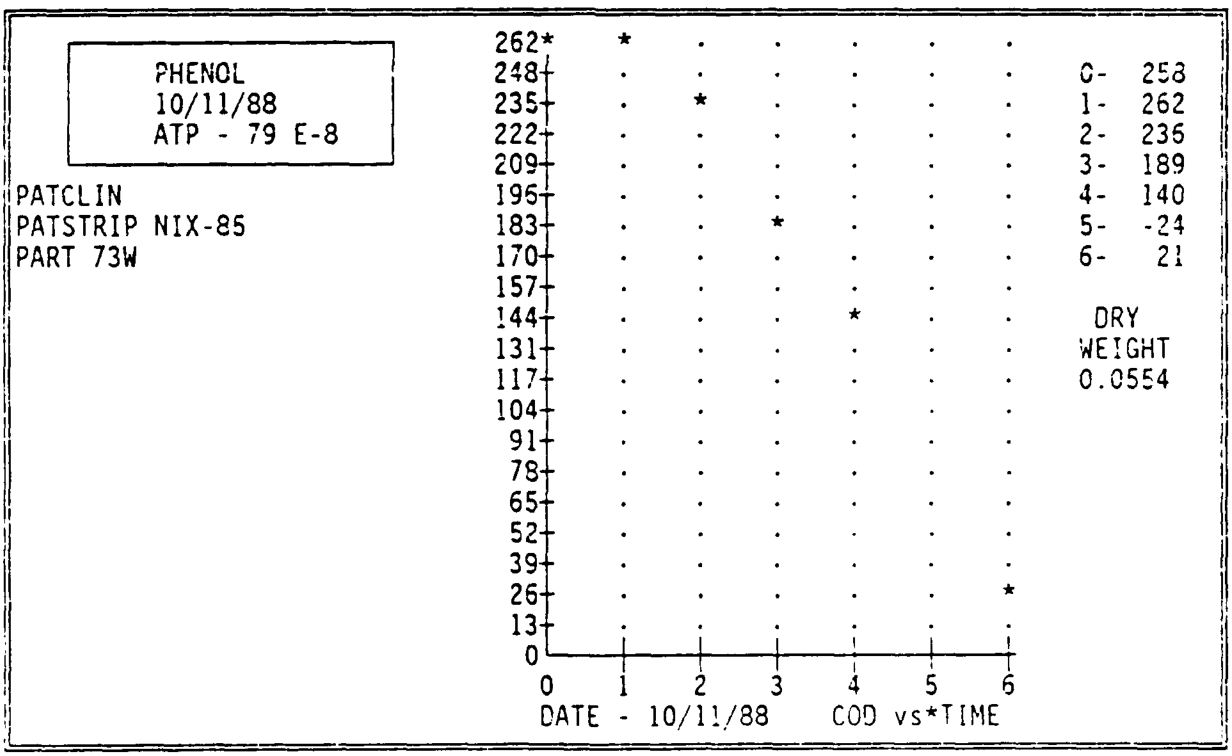
PATCLIN PATSTRIP NIX-95



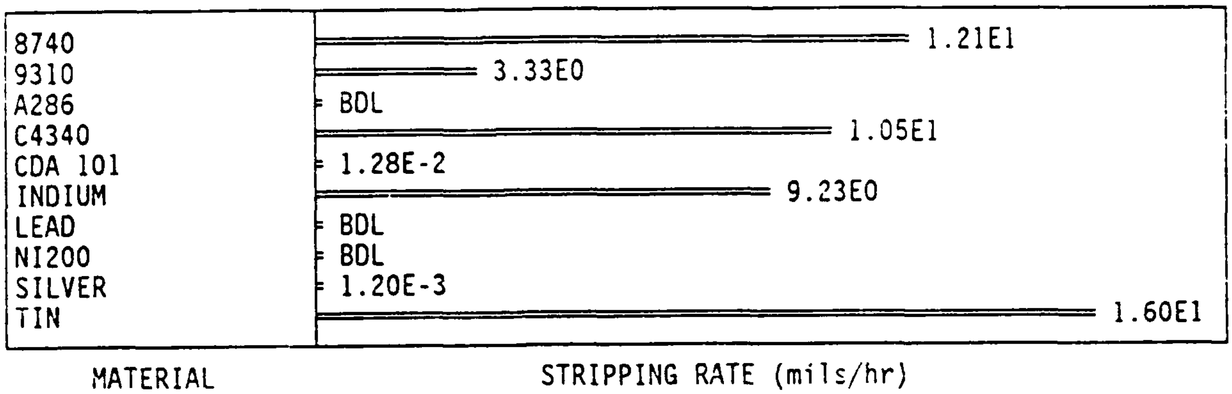

PATCLIN
PATSTRIP NIX-85
PART 72Y
0- 168
1- 153
2- 159
3- 204
4- 212
5- 222
6- 204
DRY
WEIGHT
0.0770
DATE - 09/22/88 COD vs TIME

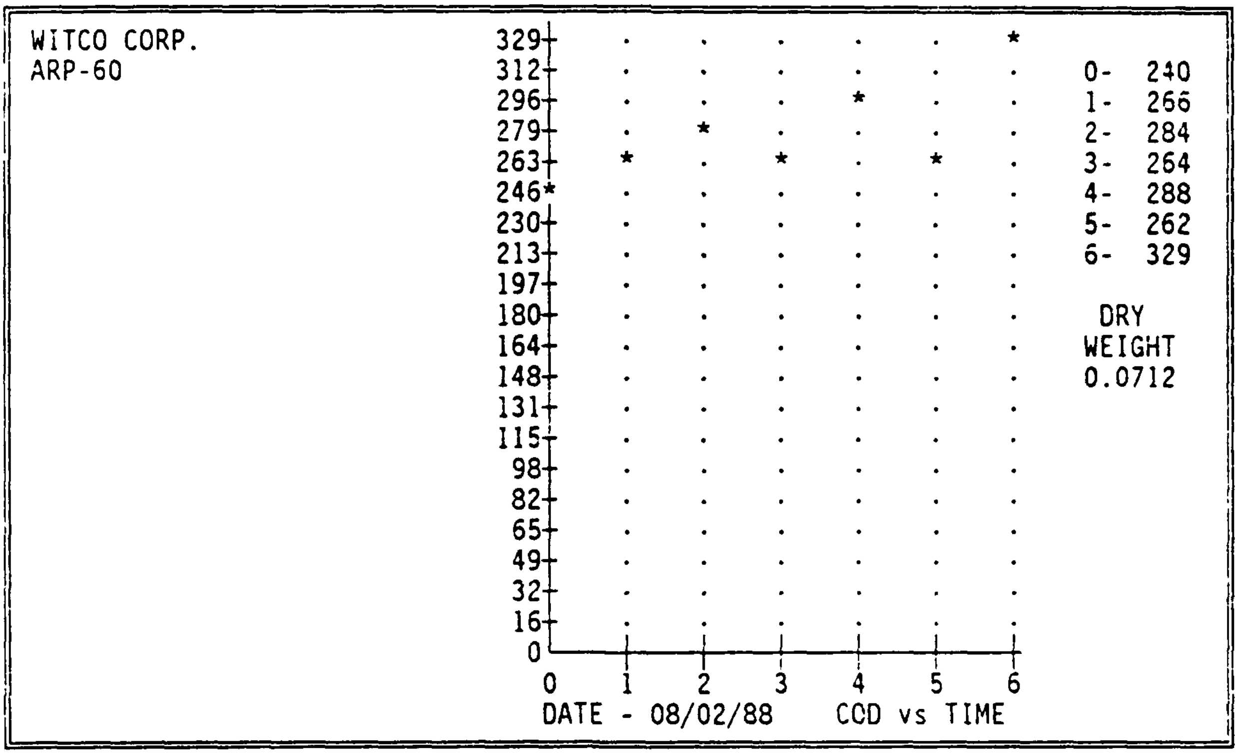

PHENOL
09/22/88
ATP - 81 E-8
OMI INT'L CORP.
UDYSTRIP 7000
PATCLIN
PATSTRIP NIX-85
PART 72Y
WITCO CORP.
ARP-66
PART 66-A
0- 310
1- 198
2- 41
3- 61
4- 22
5- 44
6- 40
DRY
WEIGHT
0.0770
DATE - 09/22/88 COD vs TIME

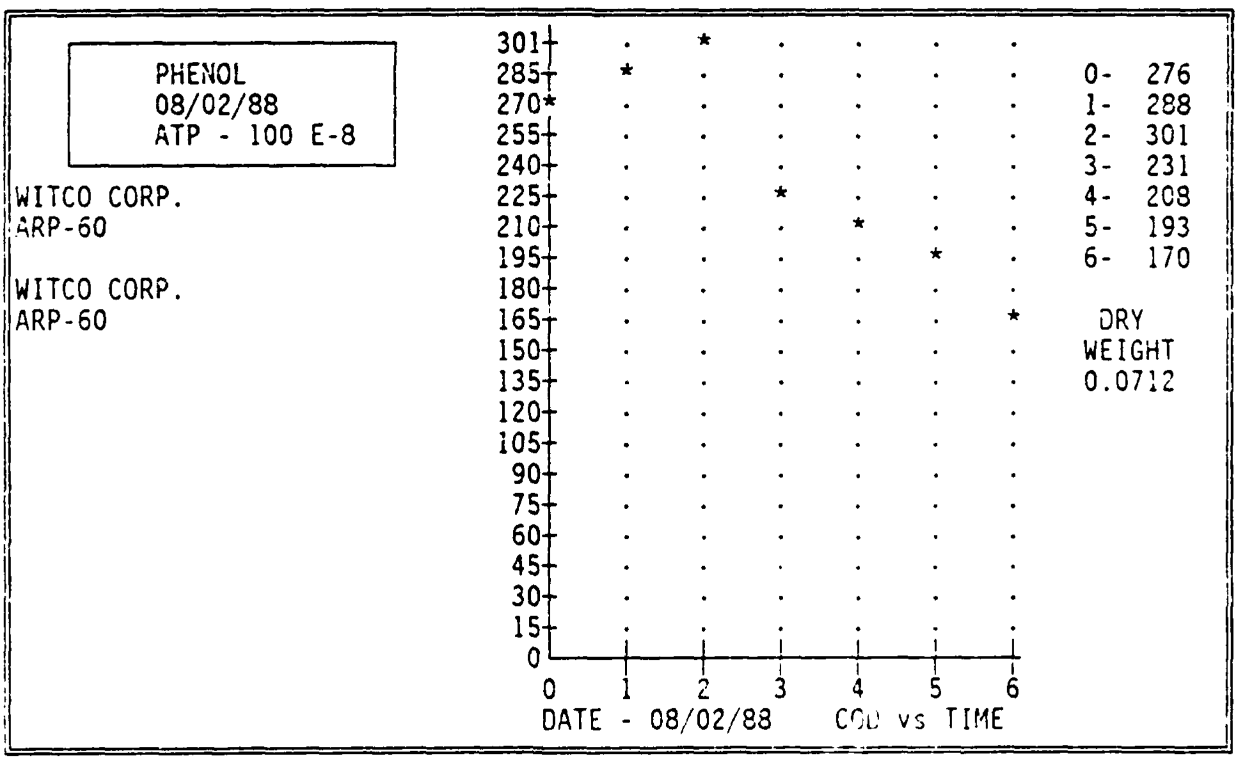

PATCLIN
PATSTRIP NIX-85
PART 73W
732
695
658
622
585
549
512
475
439
402
366
329
292
256
219
183
146
109
73
36
0
0 1 2 3 4 5 6
DATE - 10/11/88
COD vs TIME
0- 714
1- 714
2- 732
3- 726
4- 706
5- 624
6- 724
DRY
WEIGHT
0.0554

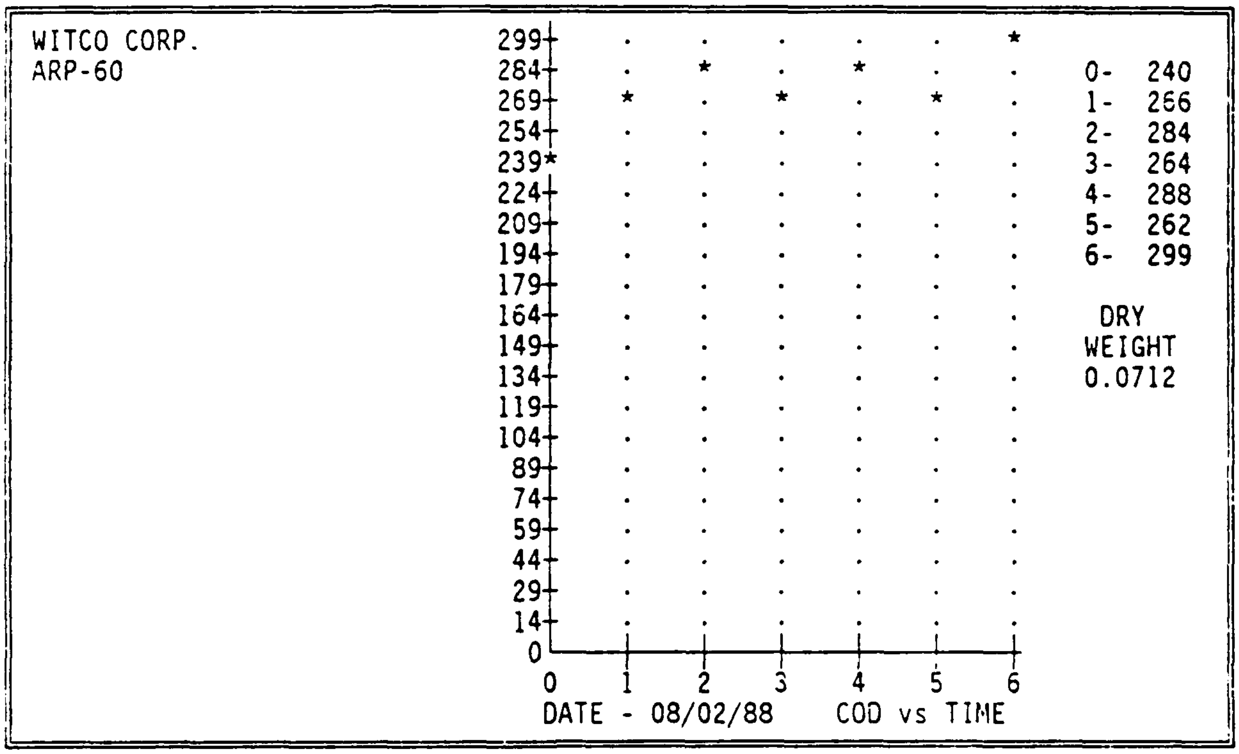

PHENOL
10/11/88
ATP - 79 E-8
PATCLIN
PATSTRIP NIX-85
PART 73W
262
248
235
222
209
196
183
170
157
144
131
117
104
91
78
65
52
39
26
13
0
0 1 2 3 4 5 6
DATE - 10/11/88
COD vs*TIME
0- 258
1- 262
2- 236
3- 189
4- 140
5- -24
6- 21
DRY
WEIGHT
0.0554

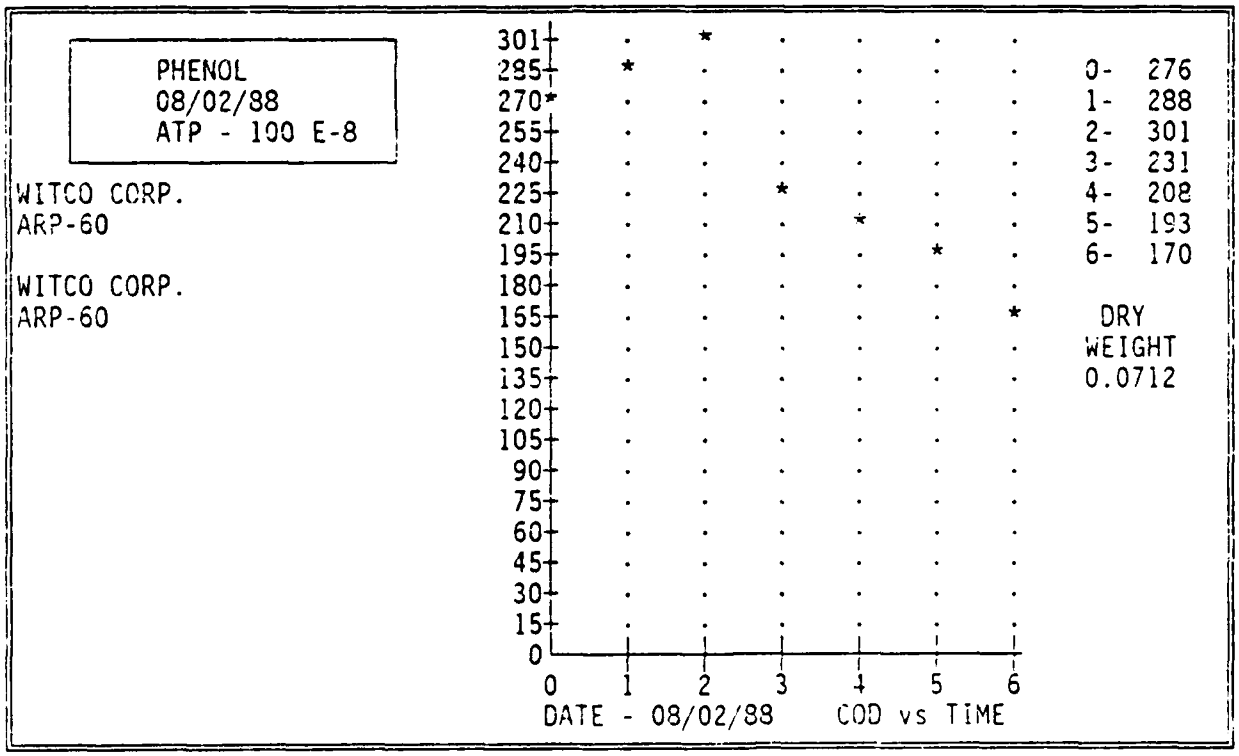
WITCO CORP. ARP-60

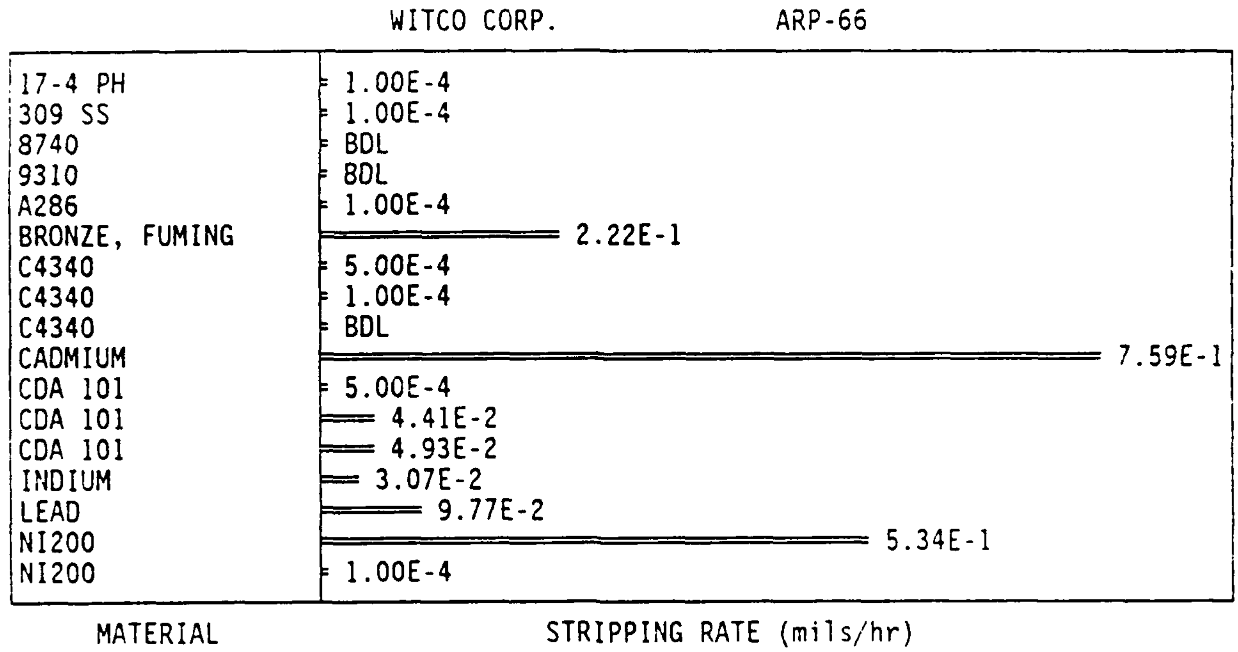



WITCO CORP.
ARP-60
329 312 296 279 263 246 230 213 197 180 164 148 131 115 98 82 65 49 32 16 0
0 1 2 3 4 5 6
DATE - 08/02/88 COD vs TIME
0- 240
1- 266
2- 284
3- 264
4- 288
5- 262
6- 329
DRY
WEIGHT
0.0712

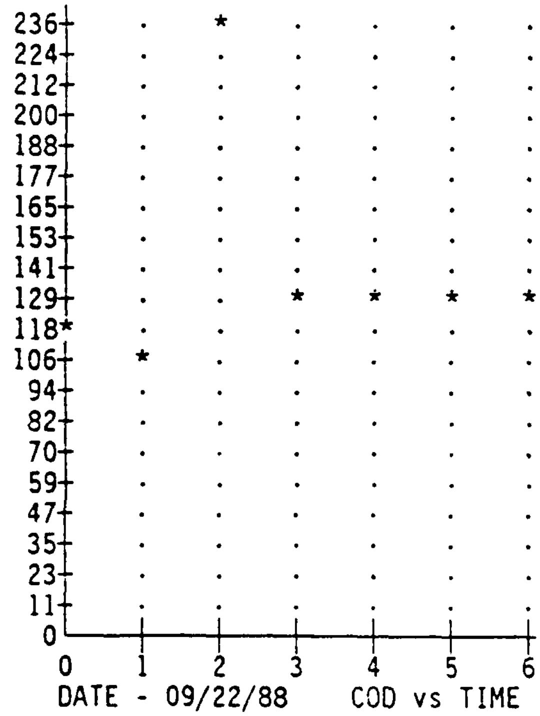

PHENOL
08/02/88
ATP - 100 E-8
WITCO CORP.
ARP-60
WITCO CORP.
ARP-60
301 285 270 255 240 225 210 195 180 165 150 135 120 105 90 75 60 45 30 15 0
0 1 2 3 4 5 6
DATE - 08/02/88 COD vs TIME
0- 276
1- 288
2- 301
3- 231
4- 208
5- 193
6- 170
DRY
WEIGHT
0.0712


WITCO CORP.
ARP-60
0- 240
1- 266
2- 284
3- 264
4- 288
5- 262
6- 299
DRY
WEIGHT
0.0712
DATE - 08/02/88
COD vs TIME


PHENOL
08/02/88
ATP - 100 E-8
WITCO CORP.
ARP-60
WITCO CORP.
ARP-60
0- 276
1- 288
2- 301
3- 231
4- 208
5- 193
6- 170
DRY
WEIGHT
0.0712
DATE - 08/02/88
COD vs TIME


WITCO CORP.
ARP-66
17-4 PH
1.00E-4
309 SS
1.00E-4
8740
BDL
9310
BDL
A286
1.00E-4
BRONZE, FUMING
2.22E-1
C4340
5.00E-4
C4340
1.00E-4
C4340
BDL
CADMIUM
7.59E-1
CDA 101
5.00E-4
CDA 101
4.41E-2
CDA 101
4.93E-2
INDIUM
3.07E-2
LEAD
9.77E-2
NI200
5.34E-1
NI200
1.00E-4
MATERIAL
STRIPPING RATE (mils/hr)

WITCO CORP.
ARP-66
PART 66-A



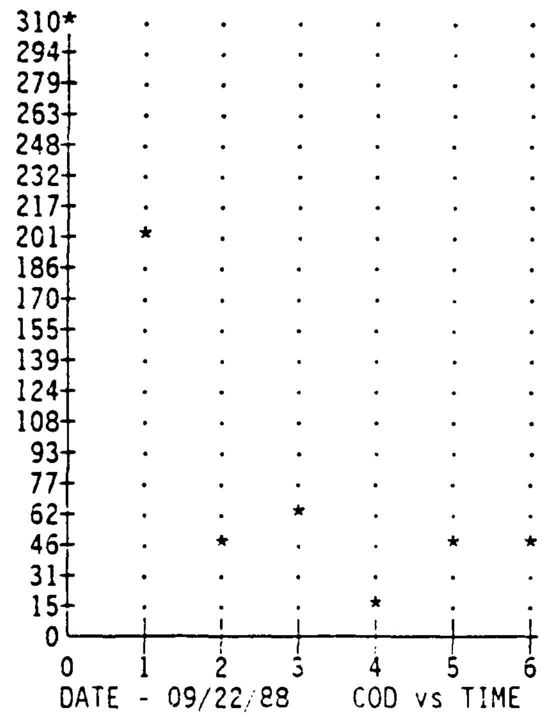
0- 116
1- 101
2- 236
3- 126
4- 125
5- 128
6- 132

DRY
WEIGHT
0.0770

PHENOL
09/22/88
ATP - 81 E-8

OMI INT'L CORP.
UDYSTRIP 7000

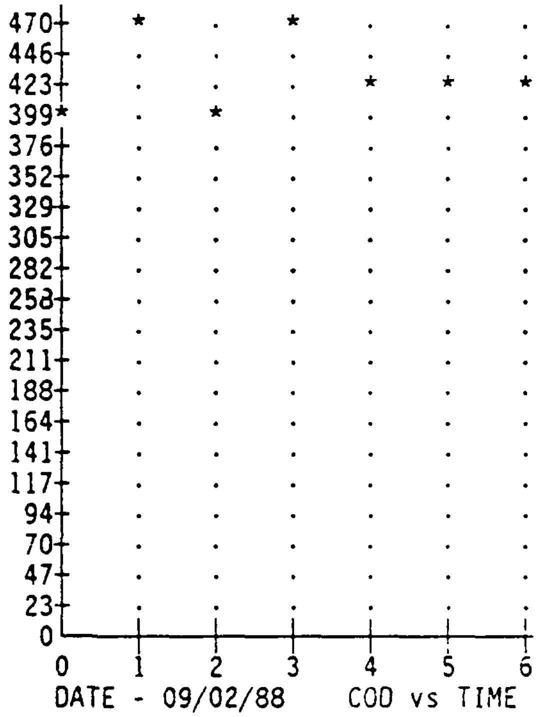
PATCLIN
PATSTRIP NIX-85
PART 72Y
WITCO CORP.
ARP-66
PART 66-A



0- 310
1- 198
2- 41
3- 61
4- 22
5- 44
6- 40

DRY
WEIGHT
0.0770

WITCO CORP.
ARP-66
PART 66-B



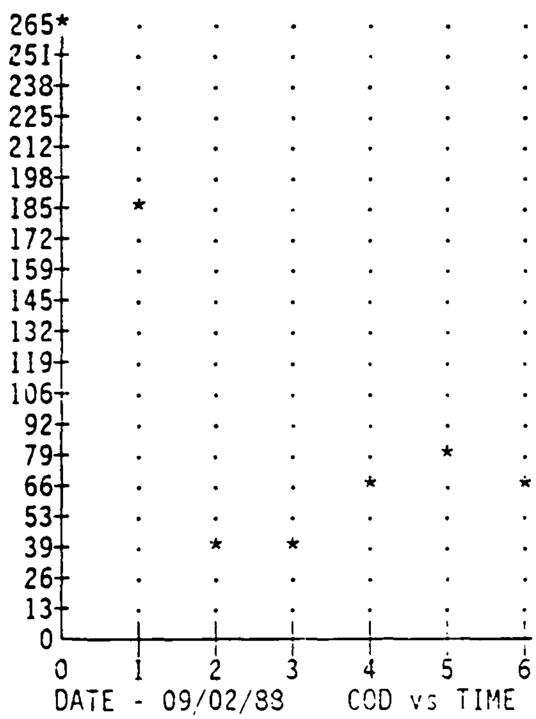
0-	392
1-	461
2-	410
3-	470
4-	427
5-	431
6-	432

DRY
WEIGHT
0.0911

PHENOL
09/02/88
ATP - 83 E-8

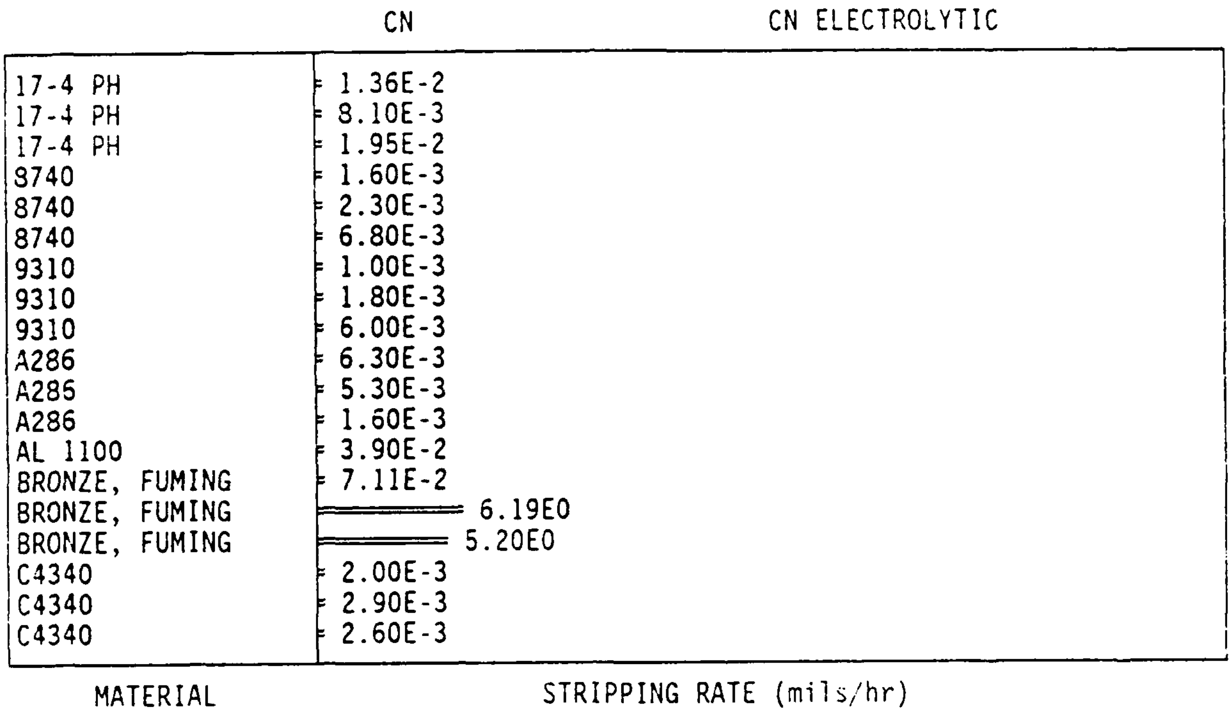
FREDRICK GUMM CHEM.
CLEPO ELECTROSTRIP B/C
PART C
METALLINE CHEM CORP.
K 72 (SN)

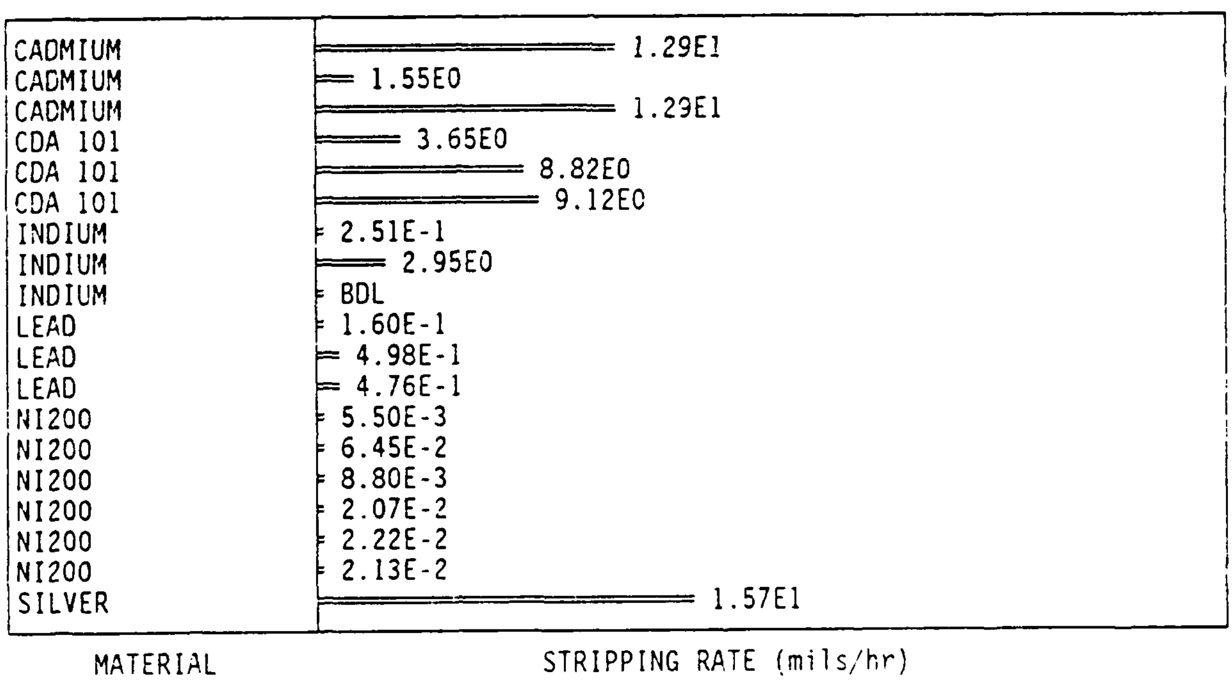
OMI INT'L CORP.
UDYSTRIP 460
PART 460 (50% ED)
OMI INT'L CORP.
UDYSTRIP XPS-306
PART 307A
WITCO CORP.
ARP-66
PART 66-B

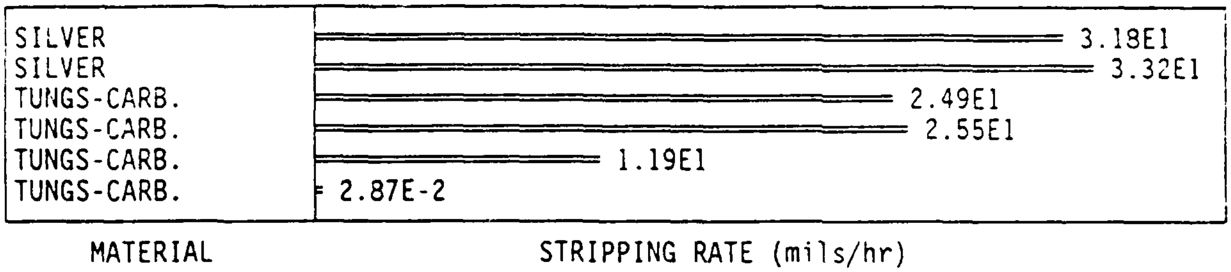


0-	265
1-	184
2-	41
3-	44
4-	63
5-	82
6-	63

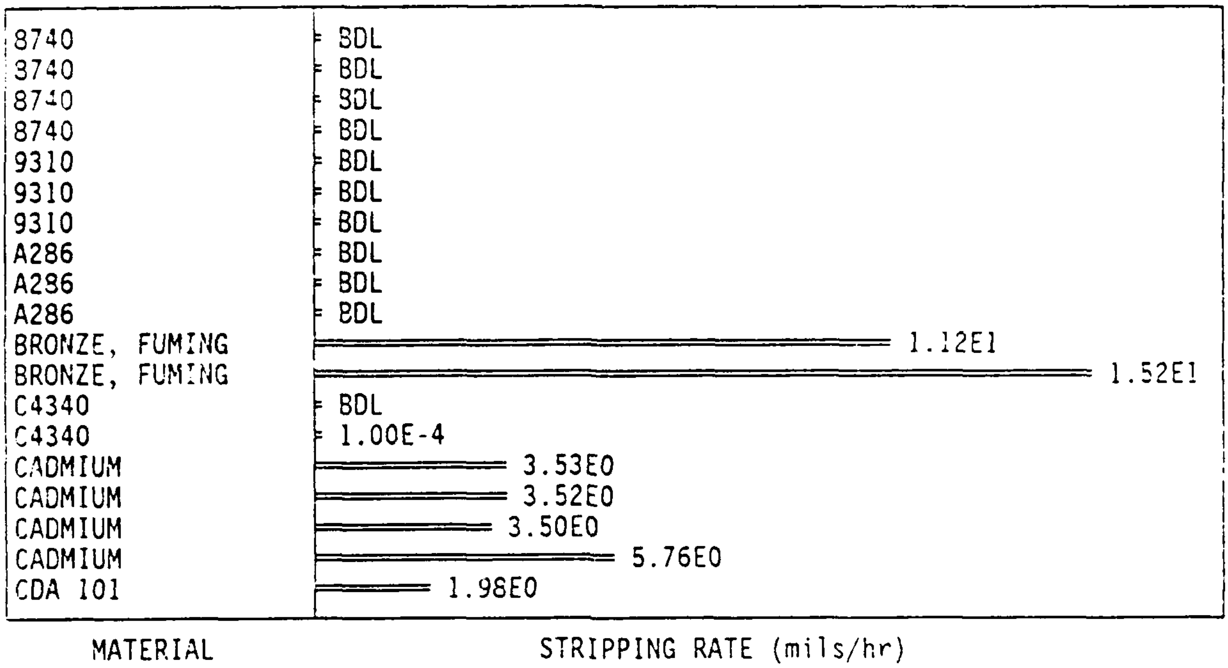
DRY
WEIGHT
0.0991

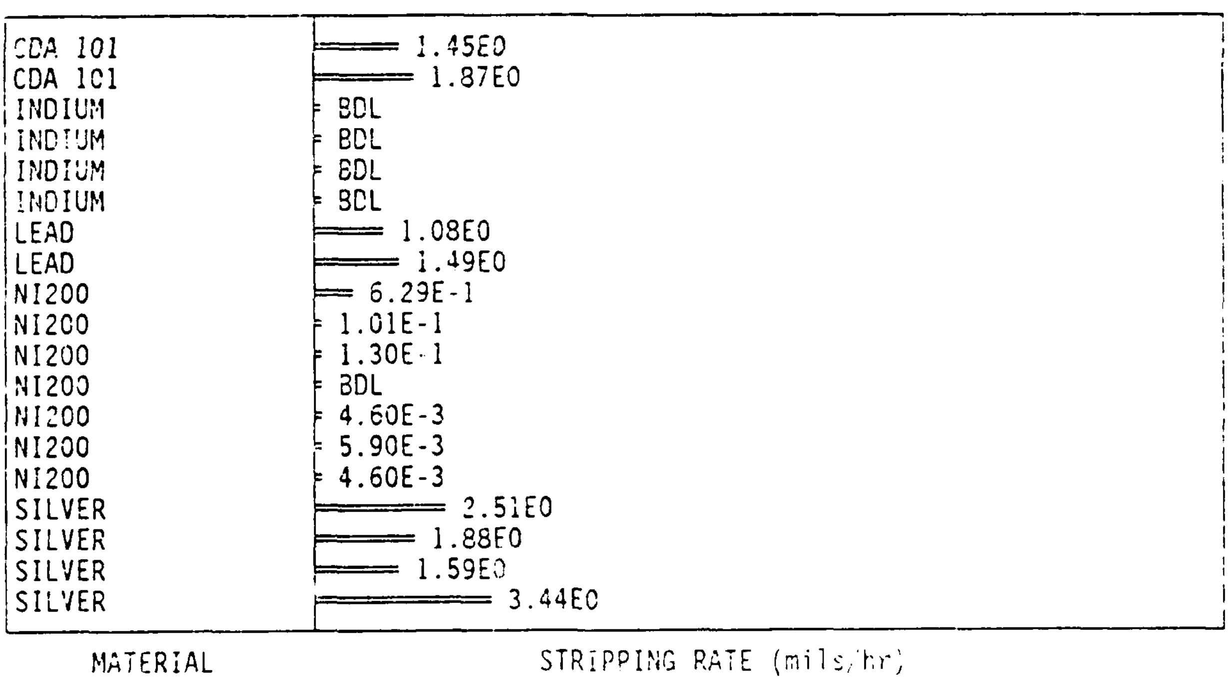

CN
CN ELECTROLYTIC
17-4 PH 1.36E-2
17-4 PH 8.10E-3
17-4 PH 1.95E-2
8740 1.60E-3
8740 2.30E-3
8740 6.80E-3
9310 1.00E-3
9310 1.80E-3
9310 6.00E-3
A286 6.30E-3
A286 5.30E-3
A286 1.60E-3
AL 1100 3.90E-2
BRONZE, FUMING 7.11E-2
BRONZE, FUMING 6.19E0
BRONZE, FUMING 5.20E0
C4340 2.00E-3
C4340 2.90E-3
C4340 2.60E-3
MATERIAL
STRIPPING RATE (mils/hr)


CADMIUM 1.29E1
CADMIUM 1.55E0
CADMIUM 1.29E1
CDA 101 3.65E0
CDA 101 8.82E0
CDA 101 9.12E0
INDIUM 2.51E-1
INDIUM 2.95E0
INDIUM BDL
LEAD 1.60E-1
LEAD 4.98E-1
LEAD 4.76E-1
NI200 5.50E-3
NI200 6.45E-2
NI200 8.80E-3
NI200 2.07E-2
NI200 2.22E-2
NI200 2.13E-2
SILVER 1.57E1
MATERIAL
STRIPPING RATE (mils/hr)

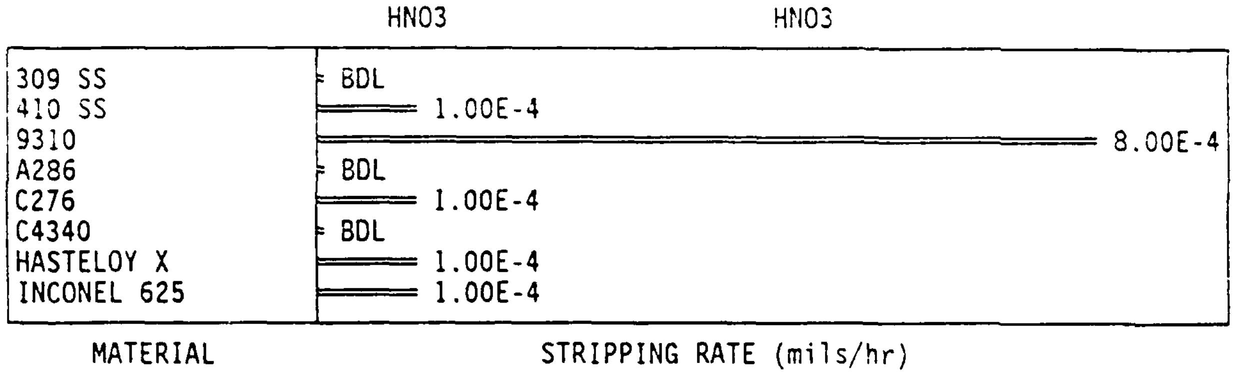

SILVER
SILVER
TUNGS-CARB.
TUNGS-CARB.
TUNGS-CARB.
TUNGS-CARB.
3.18E1
3.32E1
2.49E1
2.55E1
1.19E1
2.87E-2
MATERIAL
STRIPPING RATE (mils/hr)

CN CN IMMERSION





TUNGS-CARB.	5.06E-2
TUNGS-CARB.	3.26E-1
MATERIAL	STRIPPING RATE (mils/hr)



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APPENDIX F

STRIPPING RATES FOR A COMMON METAL

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AL 1100

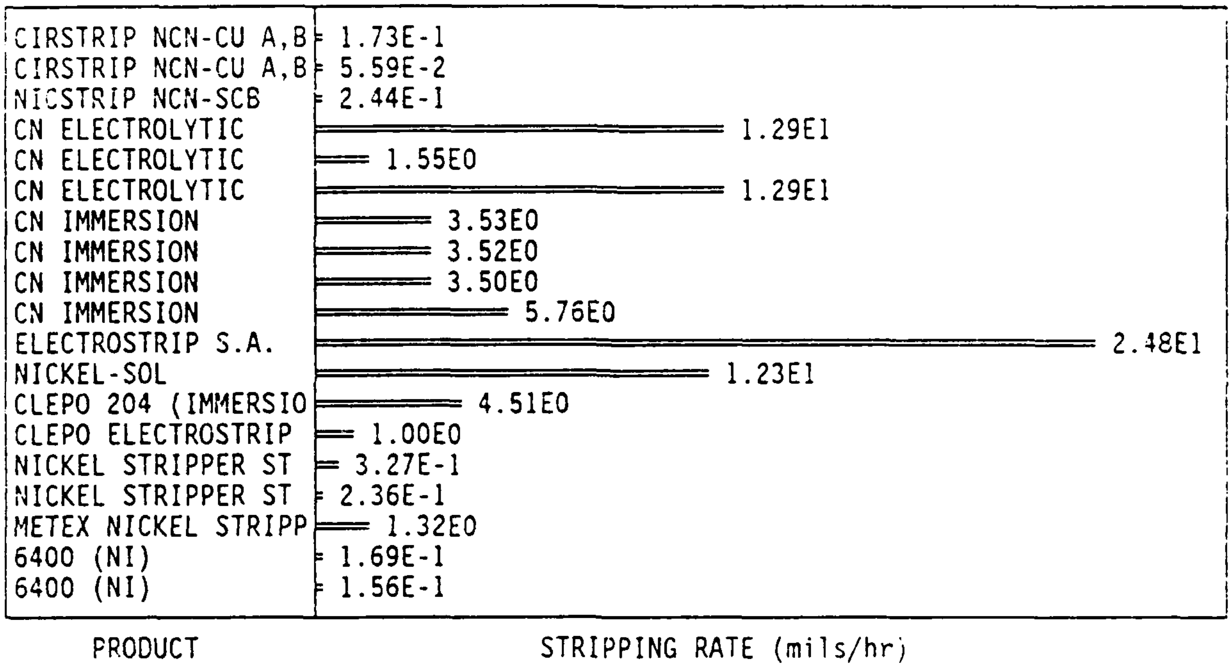
PRODUCT	STRIPPING RATE (mils/hr)
CIRSTRIP NCN-CU A,B	BDL
CN ELECTROLYTIC	3.90E-2
NICKEL-SOL	9.55E-2
OAKITE 32 (HCL SOL)	***
OXYSTRIP 6000	8.95E-2

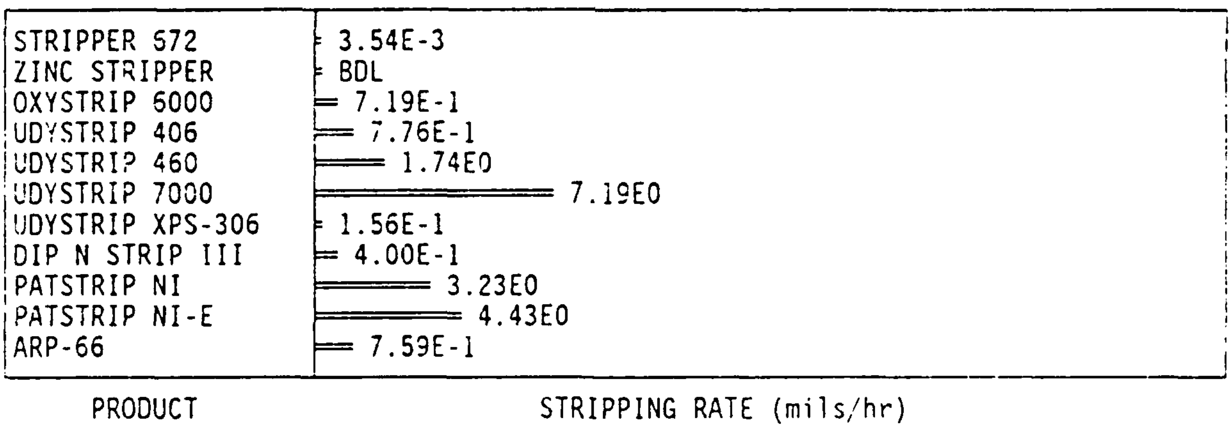
BRONZE, FUMING

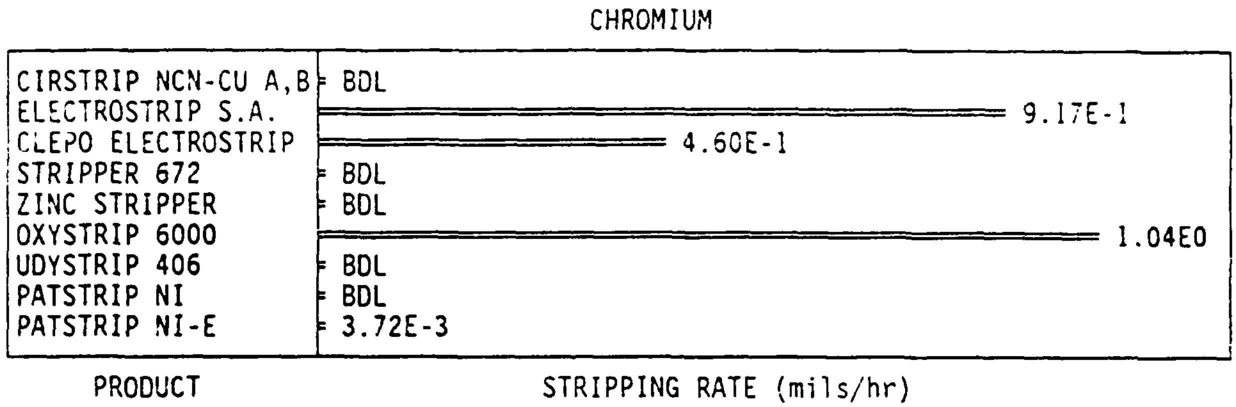
PRODUCT	STRIPPING RATE (mils/hr)
CIRSTRIP NCN-CU A,B	4.88E0
CIRSTRIP NCN-CU A,B	0E0
NICSTRIP NCN-SCB	5.99E-4
CN ELECTROLYTIC	7.11E-2
CN ELECTROLYTIC	6.19E0
CN ELECTROLYTIC	5.20E0
CN IMMERSION	1.12E1
CN IMMERSION	1.52E1
NICKEL-SOL	1.25E1
CLEPO 204 (IMMERSIO	4.05E-1
METEX NICKEL STRIPP	1.29E-2
METEX SILVER STRIPP	1.42E-1
6400 (NI)	4.80E-2
STRIPPER 672	2.34E-2
ZINC STRIPPER	5.00E-4
OXYSTRIP 6000	7.74E0
UDYSTRIP 406	2.08E-1
UDYSTRIP 460	1.80E-3
UDYSTRIP 7000	2.12E-1

PRODUCT	STRIPPING RATE (mils/hr)
UDYSTRIP XPS-306	2.43E-2
DIP N STRIP III	1.78E-1
PATSTRIP NI	BDL
PATSTRIP NI-E	1.00E1
PATSTRIP NIX-85	2.44E-3
PATSTRIP NIX-85	1.96E-2
PATSTRIP NIX-85	2.18E-2
PATSTRIP NIX-85	4.34E-2
ARP-66	2.22E-1

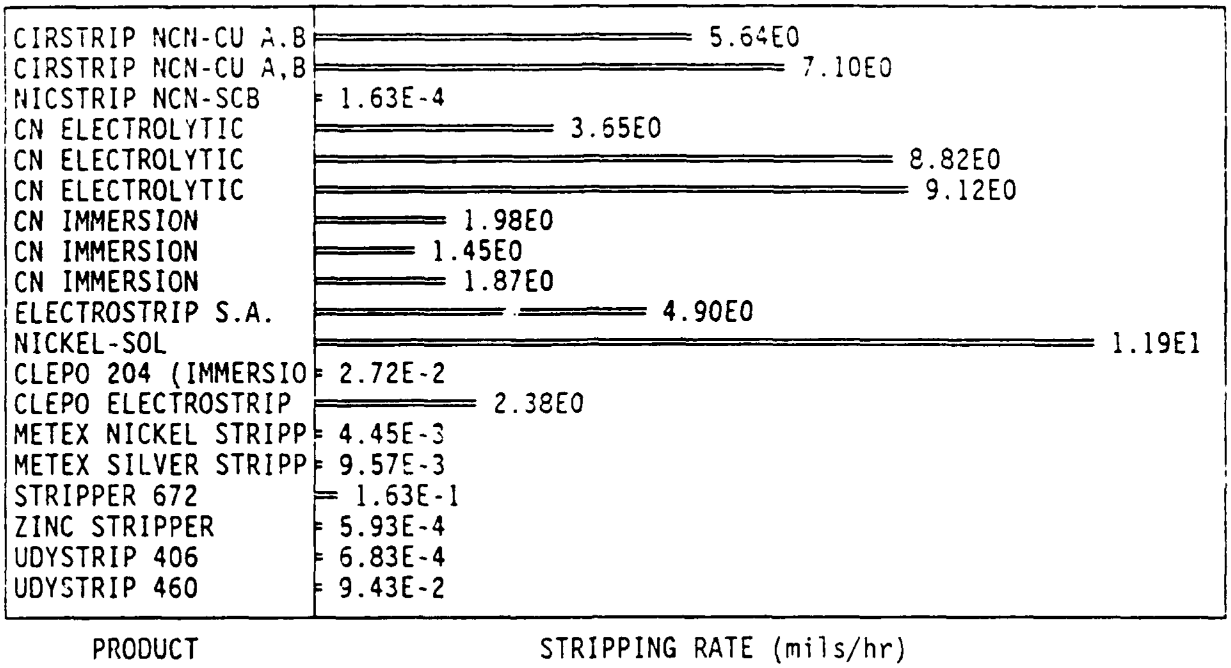
CADMIUM

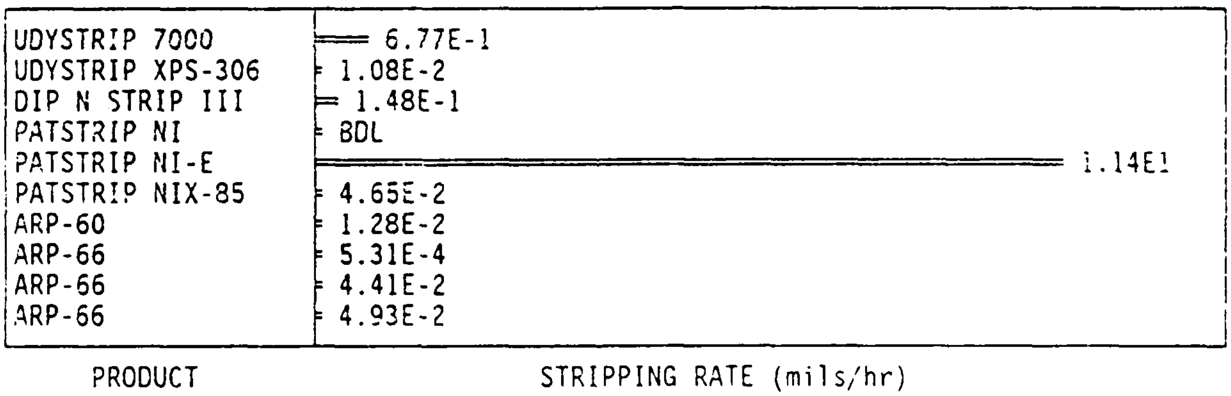

CIRSTRIP NCN-CU A,B 1.73E-1
CIRSTRIP NCN-CU A,B 5.59E-2
NICSTRIP NCN-SCB 2.44E-1
CN ELECTROLYTIC 1.29E1
CN ELECTROLYTIC 1.55E0
CN ELECTROLYTIC 1.29E1
CN IMMERSION 3.53E0
CN IMMERSION 3.52E0
CN IMMERSION 3.50E0
CN IMMERSION 5.76E0
ELECTROSTRIP S.A. 2.48E1
NICKEL-SOL 1.23E1
CLEPO 204 (IMMERSIO 4.51E0
CLEPO ELECTROSTRIP 1.00E0
NICKEL STRIPPER ST 3.27E-1
NICKEL STRIPPER ST 2.36E-1
METEX NICKEL STRIPP 1.32E0
6400 (NI) 1.69E-1
6400 (NI) 1.56E-1
PRODUCT
STRIPPING RATE (mils/hr)


STRIPPER 672 3.54E-3
ZINC STRIPPER BDL
OXYSTRIP 6000 7.19E-1
UDYSTRIP 406 7.76E-1
UDYSTRIP 460 1.74E0
UDYSTRIP 7000 7.19E0
UDYSTRIP XPS-306 1.56E-1
DIP N STRIP III 4.00E-1
PATSTRIP NI 3.23E0
PATSTRIP NI-E 4.43E0
ARP-66 7.59E-1
PRODUCT
STRIPPING RATE (mils/hr)

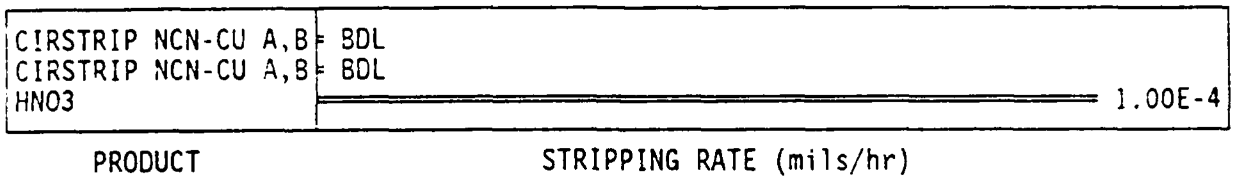

CHROMIUM
CIRSTRIP NCN-CU A,B
BDL
ELECTROSTRIP S.A.
9.17E-1
CLEPO ELECTROSTRIP
4.60E-1
STRIPPER 672
BDL
ZINC STRIPPER
BDL
OXYSTRIP 6000
1.04E0
UDYSTRIP 406
BDL
PATSTRIP NI
BDL
PATSTRIP NI-E
3.72E-3
PRODUCT
STRIPPING RATE (mils/hr)

CDA 101

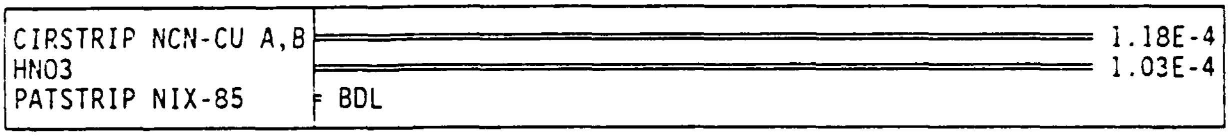

CIRSTRIP NCN-CU A.B 5.64E0
CIRSTRIP NCN-CU A,B 7.10E0
NICSTRIP NCN-SCB 1.63E-4
CN ELECTROLYTIC 3.65E0
CN ELECTROLYTIC 8.82E0
CN ELECTROLYTIC 9.12E0
CN IMMERSION 1.98E0
CN IMMERSION 1.45E0
CN IMMERSION 1.87E0
ELECTROSTRIP S.A. 4.90E0
NICKEL-SOL 1.19E1
CLEPO 204 (IMMERSIO 2.72E-2
CLEPO ELECTROSTRIP 2.38E0
METEX NICKEL STRIPP 4.45E-3
METEX SILVER STRIPP 9.57E-3
STRIPPER 672 1.63E-1
ZINC STRIPPER 5.93E-4
UDYSTRIP 406 6.83E-4
UDYSTRIP 460 9.43E-2
PRODUCT
STRIPPING RATE (mils/hr)


UDYSTRIP 7000 6.77E-1
UDYSTRIP XPS-306 1.08E-2
DIP N STRIP III 1.48E-1
PATSTRIP NI BDL
PATSTRIP NI-E 1.14E1
PATSTRIP NIX-85 4.65E-2
ARP-60 1.28E-2
ARP-66 5.31E-4
ARP-66 4.41E-2
ARP-66 4.93E-2
PRODUCT
STRIPPING RATE (mils/hr)

C276

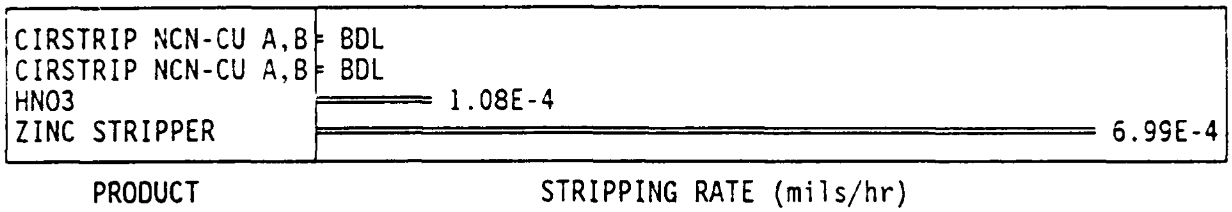

CIRSTRIP NCN-CU A,B
BDL
CIRSTRIP NCN-CU A,B
BDL
HNO3
1.00E-4
PRODUCT
STRIPPING RATE (mils/hr)

HASTELOY X

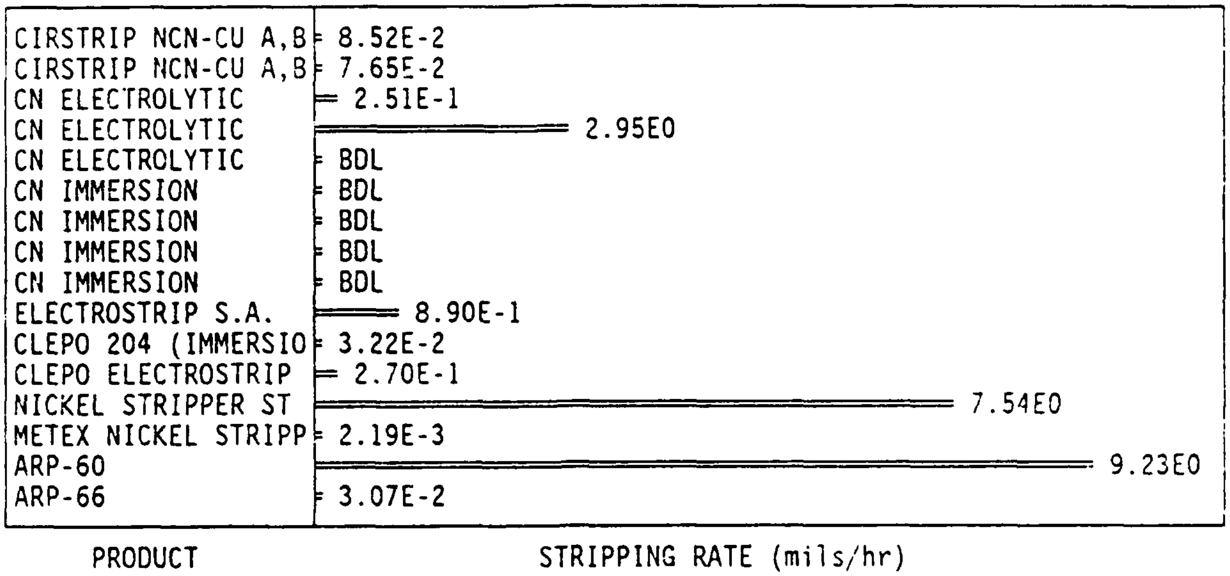


PRODUCT STRIPPING RATE (mils/hr)

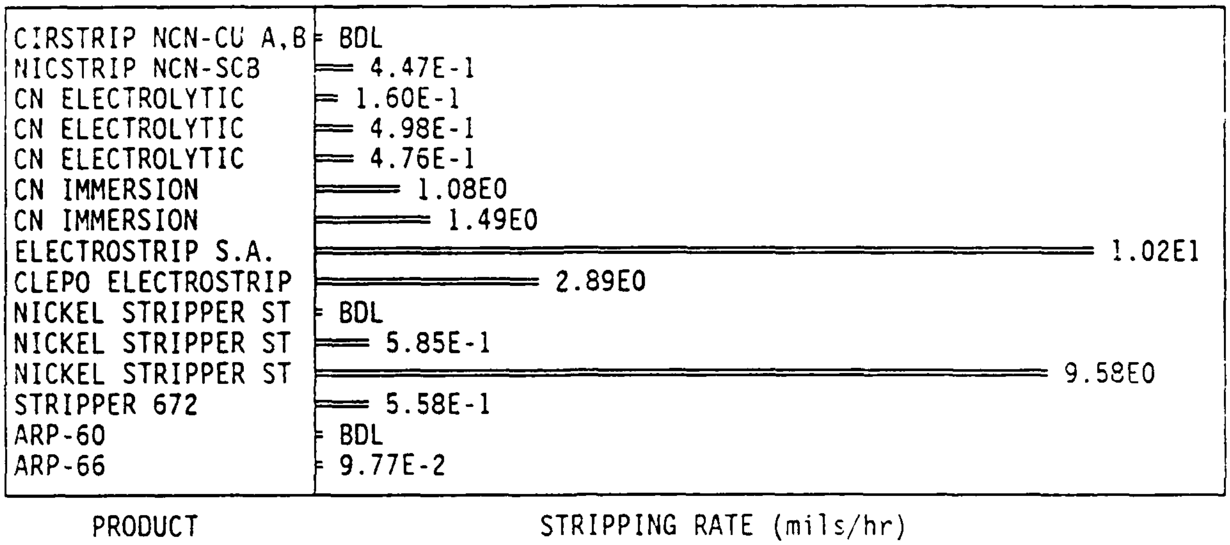
INCONEL 625


CIRSTRIP NCN-CU A,B
BDL
CIRSTRIP NCN-CU A,B
BDL
HNO3
1.08E-4
ZINC STRIPPER
6.99E-4
PRODUCT
STRIPPING RATE (mils/hr)

INDIUM


CIRSTRIP NCN-CU A,B
8.52E-2
CIRSTRIP NCN-CU A,B
7.65E-2
CN ELECTROLYTIC
2.51E-1
CN ELECTROLYTIC
2.95E0
CN ELECTROLYTIC
BDL
CN IMMERSION
BDL
CN IMMERSION
BDL
CN IMMERSION
BDL
CN IMMERSION
BDL
ELECTROSTRIP S.A.
8.90E-1
CLEPO 204 (IMMERSIO
3.22E-2
CLEPO ELECTROSTRIP
2.70E-1
NICKEL STRIPPER ST
7.54E0
METEX NICKEL STRIPP
2.19E-3
ARP-60
9.23E0
ARP-66
3.07E-2
PRODUCT
STRIPPING RATE (mils/hr)

LEAD

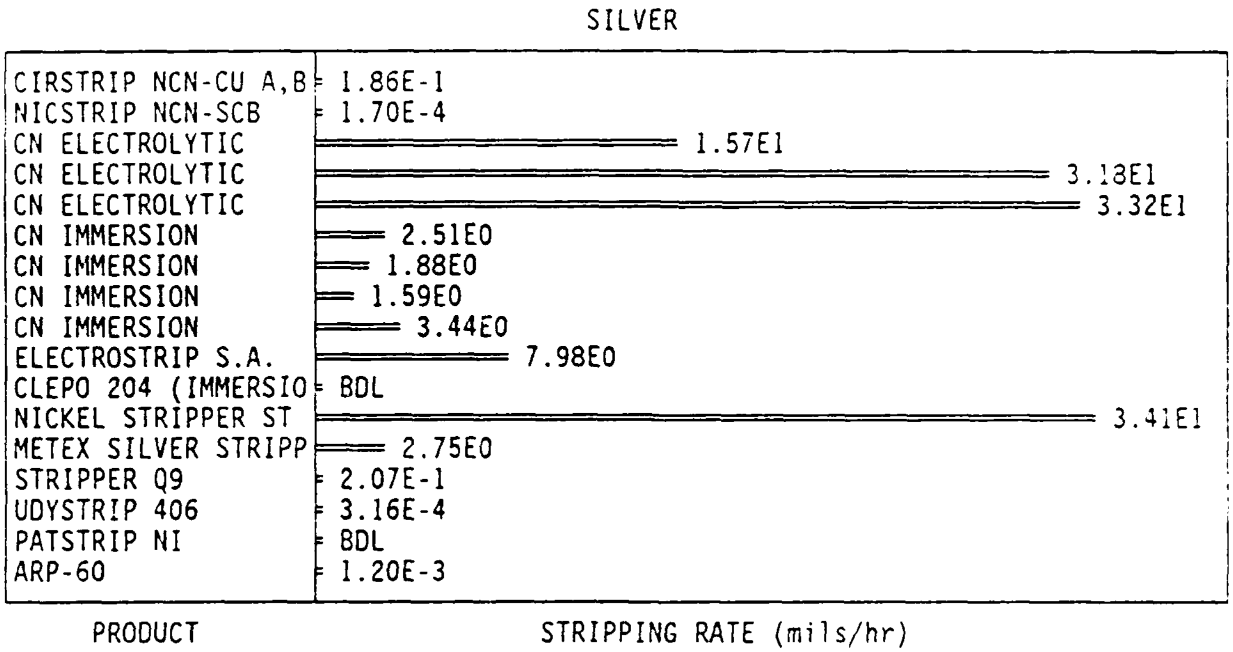

CIRSTRIP NCN-CU A,B
BDL
NICSTRIP NCN-SCB
4.47E-1
CN ELECTROLYTIC
1.60E-1
CN ELECTROLYTIC
4.98E-1
CN ELECTROLYTIC
4.76E-1
CN IMMERSION
1.08E0
CN IMMERSION
1.49E0
ELECTROSTRIP S.A.
1.02E1
CLEPO ELECTROSTRIP
2.89E0
NICKEL STRIPPER ST
BDL
NICKEL STRIPPER ST
5.85E-1
NICKEL STRIPPER ST
9.58E0
STRIPPER 672
5.58E-1
ARP-60
BDL
ARP-66
9.77E-2
PRODUCT
STRIPPING RATE (mils/hr)

NI200

PRODUCT	STRIPPING RATE (mils/hr)
CIRSTRIP NCN-CU A,B	BDL
CIRSTRIP NCN-CU A,B	6.02E-4
NICSTRIP NCN-SUB	BDL
CN ELECTROLYTIC	5.52E-3
CN ELECTROLYTIC	6.45E-2
CN ELECTROLYTIC	8.81E-3
CN ELECTROLYTIC	2.07E-2
CN ELECTROLYTIC	2.22E-2
CN ELECTROLYTIC	2.13E-2
CN IMMERSION	6.29E-1
CN IMMERSION	1.01E-1
CN IMMERSION	1.30E-1
CN IMMERSION	BDL
CN IMMERSION	4.54E-3
CN IMMERSION	5.91E-3
CN IMMERSION	4.59E-3
ELECTROSTRIP S.A.	4.10E-1
NICKEL-SOL	2.87E0
CLEPO 204 (IMMERSIO	5.42E-1

PRODUCT	STRIPPING RATE (mils/hr)
CLEPO ELECTROSTRIP	1.97E-1
NICKEL STRIPPER ST	BDL
NICKEL STRIPPER ST	2.18E-3
NICKEL STRIPPER ST	5.34E-2
METEX NICKEL STRIPP	BDL
METEX SILVER STRIPP	1.16E-1
6400 (NI)	4.10E-1
6400 (NI)	3.91E-1
STRIPPER 672	BDL
ZINC STRIPPER	BDL
OXYSTRIP 6000	2.25E0
UDYSTRIP 406	9.29E-1
UDYSTRIP 460	2.17E-4
UDYSTRIP 7000	8.00E-2
UDYSTRIP XPS-306	1.43E0
DIP N STRIP III	5.37E-2
PATSTRIP NI	1.13E0
PATSTRIP NI-E	1.37E-1
PATSTRIP NIX-85	2.21E-1

PRODUCT	STRIPPING RATE (mils/hr)
ARP-60	BDL
ARP-66	5.34E-1
ARP-66	BDL


SILVER
CIRSTRIP NCN-CU A,B 1.86E-1
NICSTRIP NCN-SCB 1.70E-4
CN ELECTROLYTIC 1.57E1
CN ELECTROLYTIC 3.18E1
CN ELECTROLYTIC 3.32E1
CN IMMERSION 2.51E0
CN IMMERSION 1.88E0
CN IMMERSION 1.59E0
CN IMMERSION 3.44E0
ELECTROSTRIP S.A. 7.98E0
CLEPO 204 (IMMERSIO BDL
NICKEL STRIPPER ST 3.41E1
METEX SILVER STRIPP 2.75E0
STRIPPER Q9 2.07E-1
UDYSTRIP 406 3.16E-4
PATSTRIP NI BDL
ARP-60 1.20E-3
PRODUCT
STRIPPING RATE (mils/hr)

C4340

PRODUCT	STRIPPING RATE (mils/hr)
CIRSTRIP NCN-CU A,B	BDL
CIRSTRIP NCN-CU A,B	BDL
NICSTRIP NCN-SCB	BDL
CN ELECTROLYTIC	2.04E-3
CN ELECTROLYTIC	2.88E-3
CN ELECTROLYTIC	2.62E-3
CN IMMERSION	BDL
CN IMMERSION	BDL
ELECTROSTRIP S.A.	2.54E-2
NICKEL-SOL	9.50E-1
CLEPO 204 (IMMERSIO	BDL
CLEPO ELECTROSTRIP	4.48E-2
HNO3	BDL
NICKEL STRIPPER ST	1.25E-3
METEX NICKEL STRIPP	BDL
METEX SILVER STRIPP	2.55E-3
6400 (NI)	BDL
STRIPPER 672	BDL
ZINC STRIPPER	BDL

LIST CONTINUED. PRESS ANY KEY TO CONTINUE

C4340

PRODUCT	STRIPPING RATE (mils/hr)
OXYSTRIP 6000	5.11E-3
UDYSTRIP 406	3.22E-1
UDYSTRIP 460	BDL
UDYSTRIP 7000	7.97E-3
UDYSTRIP XPS-306	BDL
DIP N STRIP III	BDL
PATSTRIP NI	2.34E-1
PATSTRIP NI-E	3.33E-3
PATSTRIP NIX-85	1.38E-1
PATSTRIP NIX-85	BDL
PATSTRIP NIX-85	2.31E-1
ARP-60	1.05E1
ARP-66	BDL
ARP-66	BDL
ARP-66	BDL

A286

PRODUCT	STRIPPING RATE (mils/hr)
CIRSTRIP NCN-CU A.B	BDL
NICSTRIP NCN-SC3	BDL
CN ELECTROLYTIC	6.31E-3
CN ELECTROLYTIC	5.29E-3
CN ELECTROLYTIC	1.61E-3
CN IMMERSION	BDL
CN IMMERSION	BDL
CN IMMERSION	BDL
ELECTROSTRIP S.A.	2.75E-1
NICKEL-SOL	BDL
CLEPO 204 (IMMERSIO	BDL
CLEPO ELECTROSTRIP	5.75E-3
HNO3	BDL
NICKEL STRIPPER ST	BDL
NICKEL STRIPPER ST	3.79E-3
NICKEL STRIPPER ST	0.99E-3
METEX NICKEL STRIPP	BDL
6400 (NI)	BDL
OXYSTRIP 6000	2.18E-4

PRODUCT	STRIPPING RATE (mils/hr)
UDYSTRIP 460	BDL
UDYSTRIP XPS-306	BDL
DIP N STRIP III	BDL
PATSTRIP NI-E	7.49E-2
PATSTRIP NIX-85	BDL
ARP-60	BDL
ARP-66	BDL

9310

PRODUCT	STRIPPING RATE (mils/hr)
CIRSTRIP NCN-CU A,B	2.44E-3
CIRSTRIP NCN-CU A,B	BDL
CIRSTRIP NCN-CU A,B	BDL
CIRSTRIP NCN-CU A,B	BDL
CN ELECTROLYTIC	0.98E-3
CN ELECTROLYTIC	1.83E-3
CN ELECTROLYTIC	6.01E-3
CN IMMERSION	BDL
CN IMMERSION	BDL
CN IMMERSION	BDL
ELECTROSTRIP S.A.	2.53E-2
CLEPO ELECTROSTRIP	1.30E-2
HNO3	8.10E-4
NICKEL STRIPPER ST	1.73E-3
NICKEL STRIPPER ST	5.41E-3
METEX NICKEL STRIPP	BDL
6400 (NI)	BDL
STRIPPER 672	0.55E-4
ZINC STRIPPER	BDL

PRODUCT	STRIPPING RATE (mils/hr)
OXYSTRIP 6000	3.75E-3
UDYSTRIP 406	1.30E-1
UDYSTRIP 460	BDL
UDYSTRIP 7000	2.55E-3
UDYSTRIP XPS-306	BDL
DIP N STRIP III	BDL
PATSTRIP NI-E	3.68E-3
PATSTRIP NIX-85	BDL
PATSTRIP NIX-85	0E0
ARP-60	3.33E0
ARP-66	BDL

8740

PRODUCT	STRIPPING RATE (mils/hr)
CIRSTRIP NCN-CU A,B	BDL
CIRSTRIP NCN-CU A,B	0.70E-4
CIRSTRIP NCN-CU A,B	0.70E-4
CIRSTRIP NCN-CU A,B	0.70E-4
CN ELECTROLYTIC	1.60E-3
CN ELECTROLYTIC	2.31E-3
CN ELECTROLYTIC	6.77E-3
CN IMMERSION	BDL
CN IMMERSION	BDL
CN IMMERSION	BDL
CN IMMERSION	BDL
ELECTROSTRIP S.A.	2.84E-2
CLEPO 204 (IMMERSIO	BDL
CLEPO ELECTROSTRIP	3.47E-2
NICKEL STRIPPER ST	5.19E-3
NICKEL STRIPPER ST	6.55E-3
6400 (NI)	BDL
UDYSTRIP 460	BDL
UDYSTRIP 7000	2.91E-3

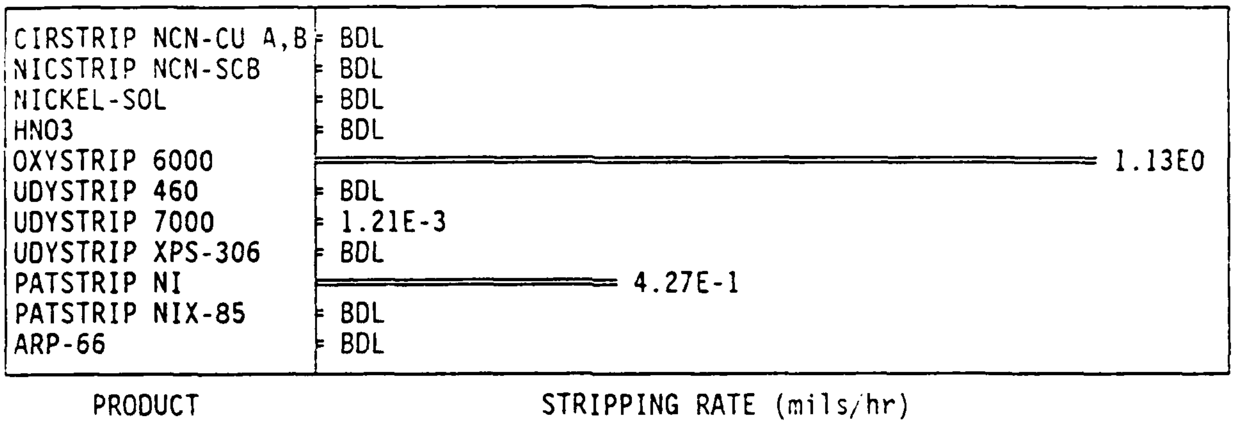
PRODUCT	STRIPPING RATE (mils/hr)
UDYSTRIP XPS-306	BDL
DIP N STRIP III	BDL
PATSTRIP NI-E	4.20E-2
PATSTRIP NIX-85	BDL
ARP-60	1.21E1
ARP-66	BDL

17-4 PH

PRODUCT	STRIPPING RATE (mils/hr)
CIRSTRIP NCN-CU A,B	0E0
CIRSTRIP NCN-CU A,B	BDL
NICSTRIP NCN-SCB	4.82E-1
CN ELECTROLYTIC	1.36E-2
CN ELECTROLYTIC	8.11E-3
CN ELECTROLYTIC	1.95E-2
NICKEL-SOL	BDL
CLEPO 204 (IMMERSIO	BDL
CLEPO ELECTROSTRIP	4.32E-1
NICKEL STRIPPER ST	0E0
METEX NICKEL STRIPP	BDL
METEX SILVER STRIPP	3.14E-4
6400 (NI)	BDL
STRIPPER 672	0.53E-4
ZINC STRIPPER	BDL
OXYSTRIP 6000	6.59E-3
UDYSTRIP 406	1.66E-1
UDYSTRIP 460	0.62E-4
UDYSTRIP 7000	2.45E-4

PRODUCT	STRIPPING RATE (mils/hr)
UDYSTRIP XPS-306	BDL
DIP N STRIP III	BDL
PATSTRIP NI	1.20E-1
PATSTRIP NI-E	1.37E0
PATSTRIP NIX-85	0E0
ARP-66	BDL

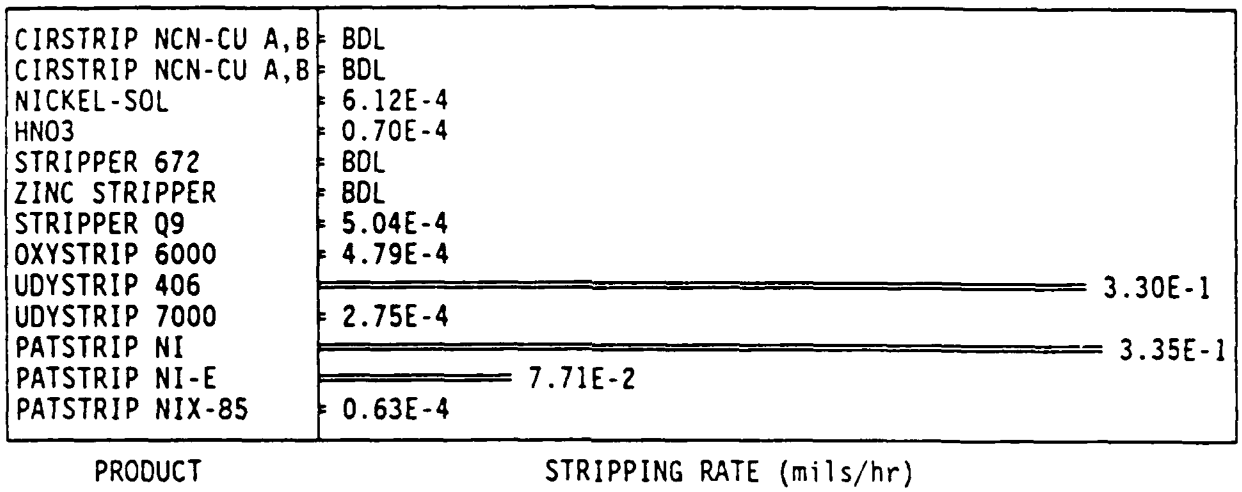
309 SS


CIRSTRIP NCN-CU A,B
NICSTRIP NCN-SCB
NICKEL-SOL
HNO3
OXYSTRIP 6000
UDYSTRIP 460
UDYSTRIP 7000
UDYSTRIP XPS-306
PATSTRIP NI
PATSTRIP NIX-85
ARP-66
BDL
BDL
BDL
BDL
1.13E0
BDL
1.21E-3
BDL
4.27E-1
BDL
BDL
PRODUCT
STRIPPING RATE (mils/hr)

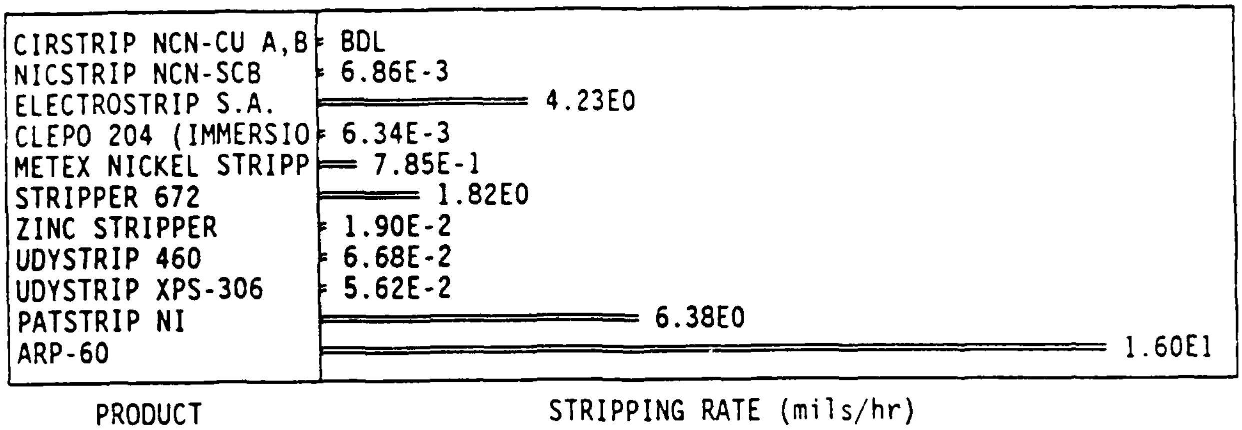
316 SS

CIRSTRIP NCN-CU A,B	OEO
NICKEL-SOL	BDL
NICKEL STRIPPER ST	OEO
PATSTRIP NIX-85	BDL
PRODUCT	STRIPPING RATE (mils/hr)

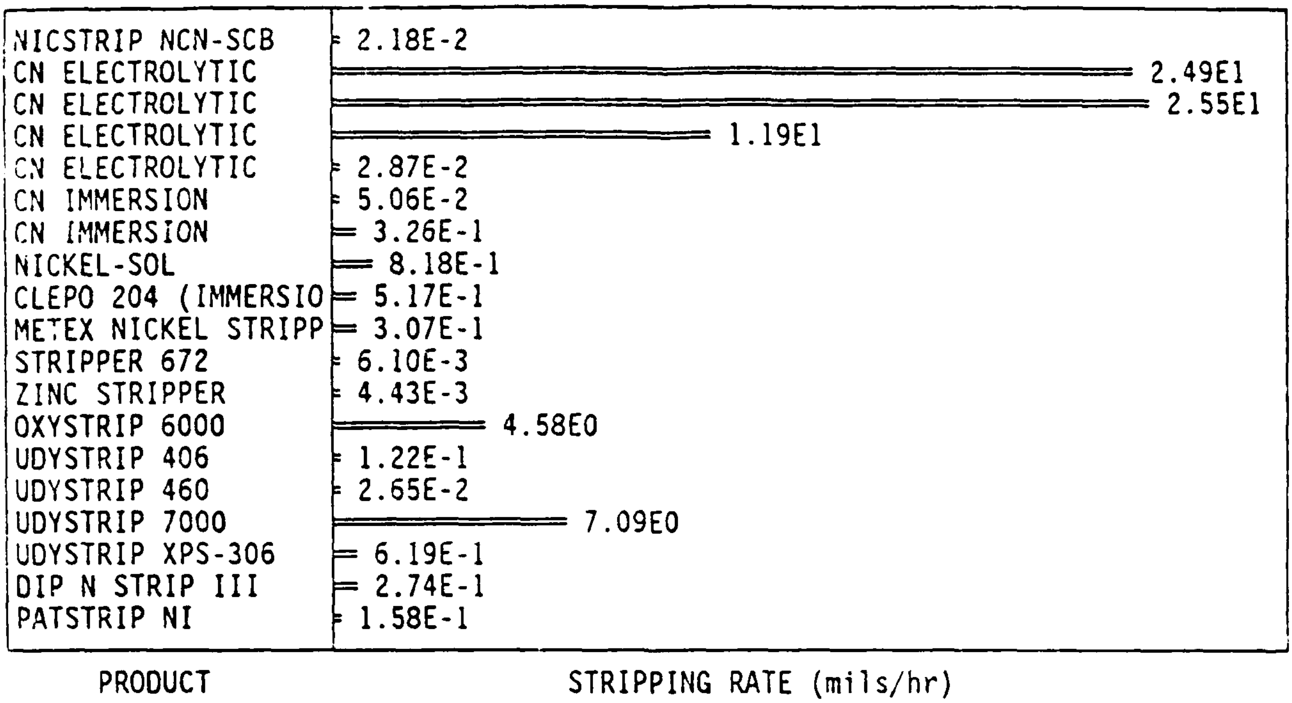
410 SS


CIRSTRIP NCN-CU A,B BDL
CIRSTRIP NCN-CU A,B BDL
NICKEL-SOL 6.12E-4
HNO3 0.70E-4
STRIPPER 672 BDL
ZINC STRIPPER BDL
STRIPPER Q9 5.04E-4
OXYSTRIP 6000 4.79E-4
UDYSTRIP 406 3.30E-1
UDYSTRIP 7000 2.75E-4
PATSTRIP NI 3.35E-1
PATSTRIP NI-E 7.71E-2
PATSTRIP NIX-85 0.63E-4
PRODUCT
STRIPPING RATE (mils/hr)

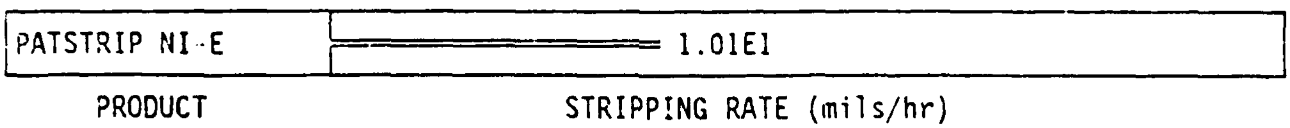
TIN


CIRSTRIP NCN-CU A,B
NICSTRIP NCN-SCB
ELECTROSTRIP S.A.
CLEPO 204 (IMMERSIO
METEX NICKEL STRIPP
STRIPPER 672
ZINC STRIPPER
UDYSTRIP 460
UDYSTRIP XPS-306
PATSTRIP NI
ARP-60
BDL
6.86E-3
4.23E0
6.34E-3
7.85E-1
1.82E0
1.90E-2
6.68E-2
5.62E-2
6.38E0
1.60E1
PRODUCT
STRIPPING RATE (mils/hr)

TUNGS-CARB.



NICSTRIP NCN-SCB 2.18E-2
CN ELECTROLYTIC 2.49E1
CN ELECTROLYTIC 2.55E1
CN ELECTROLYTIC 1.19E1
CN ELECTROLYTIC 2.87E-2
CN IMMERSION 5.06E-2
CN IMMERSION 3.26E-1
NICKEL-SOL 8.18E-1
CLEPO 204 (IMMERSIO 5.17E-1
METEX NICKEL STRIPP 3.07E-1
STRIPPER 672 6.10E-3
ZINC STRIPPER 4.43E-3
OXYSTRIP 6000 4.58E0
UDYSTRIP 406 1.22E-1
UDYSTRIP 460 2.65E-2
UDYSTRIP 7000 7.09E0
UDYSTRIP XPS-306 6.19E-1
DIP N STRIP III 2.74E-1
PATSTRIP NI 1.58E-1
PRODUCT
STRIPPING RATE (mils/hr)



PATSTRIP NI-E 1.01E1
PRODUCT
STRIPPING RATE (mils/hr)